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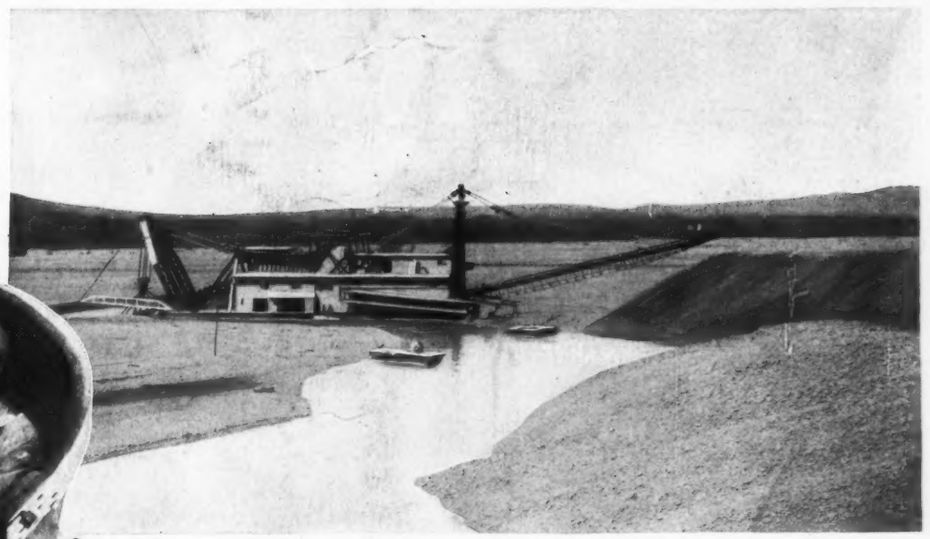

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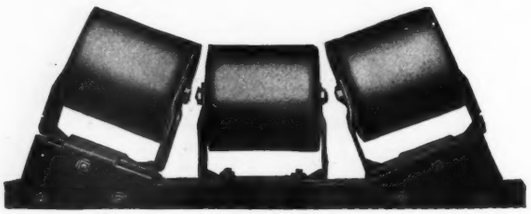

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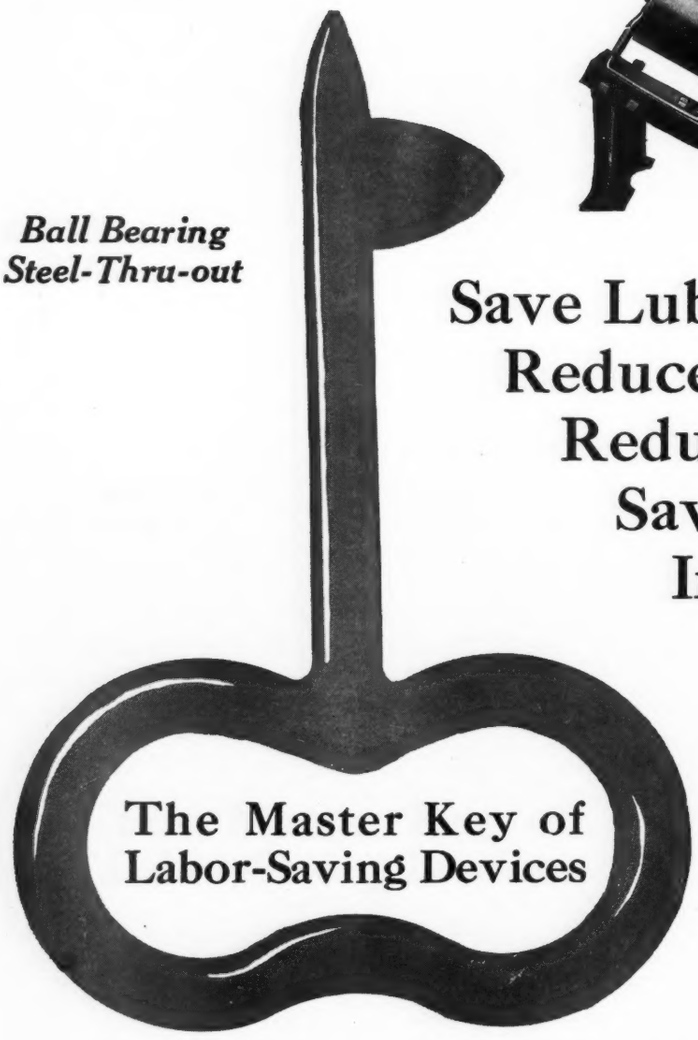

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Engineering and Mining Journal

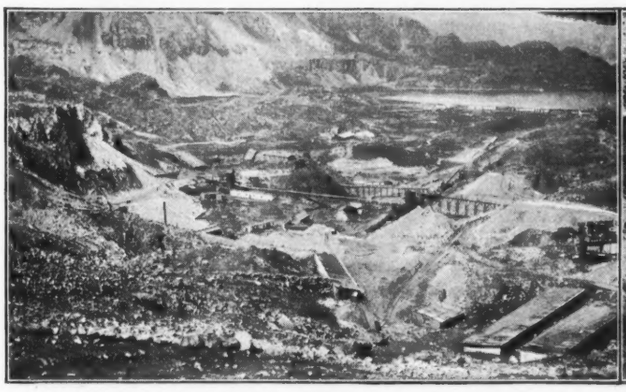
VOLUME 102 NOVEMBER 18, 1916 NUMBER 21

The Morococha and Casapalca Districts in Peru

By Joseph T. Singewald, Jr.* and Benjamin LeRoy Miller†

SYNOPSIS—The Morococha and Casapalca districts are in the the Department of Junin, Peru, and have both responded to the stimulus of American capital. The mines produce copper, silver and zinc. The principal mines are operated by the Cerro de Pasco and the Backus & Johnston companies, but there are other independent mines that are producing. The district is in high country, reaching at times over 15,000 ft., and the orebodies are of diverse character. The individual features of the mines are described.

There are two old mining districts in the Department of Junin, Peru, near the summit of the Cordillera Occidental and close to the Oroya railroad, that under the stimulus of American capital have developed considerable activity during the last few years and become really important producers. These are the Morococha district on the east side of the divide, and the Casapalca district on the west. Practically nothing of a definite descriptive nature has been published about them in recent mining literature, and it is the purpose of this article to provide such information.



VIEW OF MOROCOCHA MINES FROM CHURRUCA MINE

CHURRUCA OPENCUT, SHOWING OLD UNDERGROUND WORKINGS

The Morococha District

The Morococha district lies on the east side of the Cordillera Occidental in the Department of Junin, a short distance to the north of the Ferrocarril Central del Perú, known as the Oroya railroad. It is connected with that line at Ticlio, the highest station on the west side of the divide, by a branch line 9 mi. in length that crosses the divide at an elevation of 15,865 ft. and then descends to the town of Morococha to an elevation of 14,800 ft. This branch enjoys the distinction of being the highest railroad in the world and is 51 ft. higher than its nearest competitor, the Potosi branch of the Antofagasta & Bolivia Ry. in Bolivia. At the same time it affords the most magnificent scenery that can be seen from a railroad anywhere in the Andes, equaling that of the main line in ruggedness and excelling it in the magnificence of the glaciers that seem to be hardly a stone's throw from the car windows. It is 166 km. by rail from Lima to Morococha.

Morococha is one of the old mining districts of Peru and in its earlier history furnished argentiferous lead ores with more or less gold. After the independence of Peru was established, there was but little activity in the district until the advent of L. Pflücker & Sons in about 1850. They erected an amalgamation and lixiviation plant at Tuctu and enjoyed practically a monopoly of the district until 1886, when the Monteros came in and planned developments on a large scale which only in part materialized. They erected a concentrator below Lake Huascacocha and began the construction of a narrow-gage railroad connecting with the mines, but which was never completed. The richer ores in these days carried as high as 50% Pb and more ounces of silver than per cent. of lead.

Before 1894 the only copper ores worked in the district were sulphates from the oxidized ores of the San Miguel

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†Professor of geology, Lehigh University, South Bethlehem, Penn.

mine, for use in the Tuctu plant. In that year larger-scale operations were started at this mine, and from that time the district was gradually converted into a copper camp, until now the argentiferous lead ores are completely neglected. The district rivals Cerro de Pasco as the most active and important metal-mining district in Peru. Two factors have brought this about—the advent of the railroad and, to an even greater degree, the entrance of American capital about ten years ago. The two large American mining companies in that part of Peru, realizing the possibilities of the district, began acquiring the various small properties and consolidating them into larger mines warranting systematic and extensive development. Both of them—the Cerro de Pasco Mining Co. and the Backus & Johnston company—had their own smelteries for treating the ores, that of the former company being at Fundicion, near Cerro de Pasco, on the company's railroad, 180 km. by rail from Morococha, and that of the latter at Casapalca, on the Oroya railroad, 20 km. distant. A third American company to enter the district at this time through the purchase of the Churruca mine was the Peruvian Mining, Smelting and Refining Co., controlled by the United States Smelting, Refining and Mining Co. It erected a smeltery at Rio Blanco on the Oroya railroad, 25 km. below Casapalca, which was put in blast in 1908, but operated only a short time. The Churruca mine is now operated by Backus & Johnston. The mines acquired by the Cerro de Pasco Co. are now owned by the Morococha Mining Co., which is the largest operator in the district.

The monthly production has reached 20,000 tons of ore averaging about 12 oz. Ag. and 10% Cu. Most of this comes from the mines of the Morococha Mining Co. and of the Backus & Johnston company. The remainder comes chiefly from the La Huillca and La Vieja mines of the Sociedad Minera La Huillca, a Peruvian company, and from the Alexandria mine. The ores from the former are treated at a small customs plant on the shores of Lake Huacracocha, owned and operated by John Galliver, and those from the latter at the Casapalca smeltery. The ores of the small operators, aggregating a very small tonnage, must be disposed of to the three plants already mentioned.

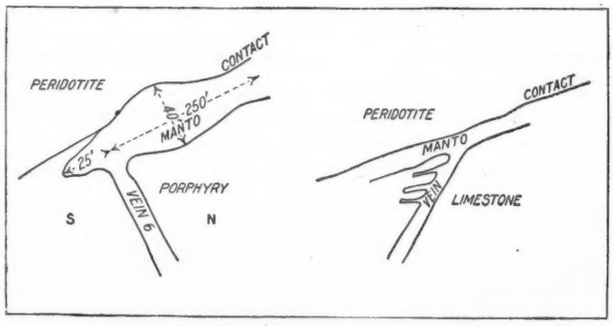
The Geography and Geology of the District

The district lies in a nearly east-west trending valley with its outlet to the east, though the railroad comes in over the divide from the west, bordered by extremely rugged and high mountain ranges; those on the north side are covered by numerous glaciers and culminate in the magnificent pyramidal, glacier-covered peak of Yanacinga. In the valley are three large lakes known respectively from west to east as Huacracocha, Morococha and Huascacocha, with elevations of 15,200, 14,800 and 14,300 ft. The town of Morococha lies at the south end of Morococha Lake, and the active portion of the district centers about it. The section of greatest activity lies between Huacracocha and Morococha Lakes and is comprised within an area roughly one mile square. Another active area is in the gulch opening into Morococha Lake from the south above the town.

The geology of the district has never been worked out, but it is apparent from merely a hasty visit that it offers many interesting problems. There are both igneous and sedimentary rocks present. The sedimentaries consist of a great series of limestones and quartzites of Mesozoic age, in part, at least, Cretaceous. Two kinds of igneous rock are of importance in connection with the orebodies, which formerly went under the names of andesite and greenstone, but which have recently been determined by Prof. C. P. Berkey, of Columbia University, to be porphyry and peridotite. The ores occur in both the sedimentary and igneous rocks.

Two kinds of ores occur in the district—the silver-lead ores, which are not being worked, and the more or less argentiferous copper ores that provide the present output. The following description is in reference to the latter class only. These ores average from 8% to 10% copper, with a silver content in ounces somewhat greater than that figure. Under favorable conditions ores running as low as 5% or 6% copper can be worked. The average copper content of the ores of this district is higher than that at Cerro de Pasco.

It is doubtful whether any other mining district of equal area possesses such a diversity of orebodies as regards shape and geologic position as does this district. It is, in fact, in these respects the most interesting and varied of the many districts visited in Latin America. From point of output, most important are the veins in the porphyry. Where these veins reach the contact of porphyry and peridotite, if the contact is steep, they rapidly



VEINS TERMINATING IN "MANTOS"

At the left is vein 6, terminating at the flat contact of porphyry and peridotite. At the right is the termination of a vein, in the Isabel mine, as "manto" against peridotite contact, with enlargements along bedding planes on hanging-wall side

fray out, but if relatively flat, the orebody spreads along the contact to form the flat-lying masses of considerable horizontal extent known as *mantos*. The filling of the veins usually consists of quartz and pyrite with enargite and tetrahedrite as the copper minerals. The relative abundance of the last two minerals varies from vein to vein and even in different stopes of the same vein. In some veins sphalerite is a prominent constituent.

The other extreme is represented by veins entirely in limestone. These are replacement veins in which replacement has been particularly prominent along certain beds, causing local horizontal enlargements which may be repeated at several horizons. In some cases the original bedding of the limestone is preserved in the ore. The ores of these veins are characterized by the predominance of chalcopyrite with some bornite as the copper minerals, to the subordination or almost complete absence of the sulphantimonides found so abundantly in the veins in the igneous rock. The principal filling is quartz and pyrite with a little sphalerite and galena.

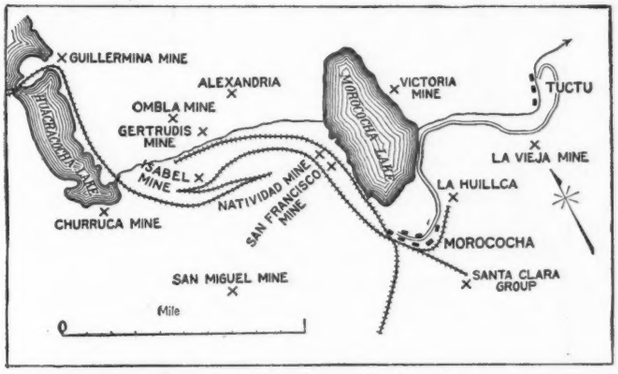
A closely allied type is represented by replacement veins in limestone of the same nature as the preceding,

but which are terminated by a great *manto* at the contact of the limestone with overlying peridotite. A fourth type is that of *manto*-like replacements in limestone lying upon a foot wall of igneous rock which is cut by narrow veins with the same filling as the *manto*. The Guillermina mine belonging to this type supplies rich silver ores characterized by the presence of rhodonite and rhodochrosite. Still another type is illustrated by the Churruca mine, which seems to be an irregular replacement in limestone. The chief copper mineral is chalcopyrite.

Judging from the mines visited, chalcopyrite is more characteristic of the ores in limestone, occurring in but very small quantity in those in the igneous rock. The conditions of occurrence of enargite are almost the opposite, whereas tetrahedrite is found abundantly in both. Pyrite and quartz are the most abundant minerals and are always present, while rhodochrosite and rhodonite are local in their occurrence. Galena is not very abundant in the copper ores, but in some of the mines sphalerite occurs in large quantity.

Characteristics of the Mines

In the preceding paragraphs the general characteristics of the ores and ore deposits have been summarized, and it is now proposed to describe briefly some of the more important mines in order to bring out more clearly those



MAP OF CENTRAL PART OF MOROCOCHA DISTRICT, SHOWING PRINCIPAL MINES

features. The situations of the mines are shown on the accompanying map. The mines of the Morococha Mining Co. will be described first.

The San Francisco mine is the most important producer of the district. It is working a system of branching veins with an east-west strike and variable dips ranging from 60° N. to 70° S. Owing to the inadequacy of the pumping facilities to handle all the water, a number of the veins have been bulkheaded and work is confined to the two most important, known as Nos. 4 and 6. These are worked through a shaft in which level 1 is at the level of Morococha Lake and the lowest level, 5, at that of the drainage tunnel being driven to unwater the mine about 400 ft. lower.

The filling of vein 4 consists chiefly of pyrite with enargite and contains but little tetrahedrite and not much gangue. The walls are usually well defined with a distinct parting. Vein 6 differs from vein 4 in carrying less enargite and more tetrahedrite.

At the east end of vein 4 is a steep porphyry-peridotite contact at which it pinches to an unworkable stringer, which is said to be the usual experience at the contact of these rocks where it is steep. Another body of peridotite is encountered at the west end of the mine, where it overlies the porphyry with a gentle southwesterly dipping contact. The vein likewise terminates at this contact, but in doing so the orebody spreads out into a great horizontal *manto*. The termination of vein 6 at this contact is shown in the cross-section on p. 890. A little to the east of this point the porphyry is cut by a small peridotite dike, and while the vein is continuous across this dike and has its normal width and filling on each side, it consists only of a narrow, gouge-filled fissure in the peridotite. These phenomena indicate that the peridotite did not fracture nearly so readily as the porphyry and that ore-bearing solutions rising in fractures in the porphyry were dammed and spread out along flat contacts with overlying peridotite.

The Natividad mine adjoins the San Francisco on the north and works part of the same system of veins. It is owned jointly by the Morococha Mining Co. and the Backus & Johnston company. Operations have been nearly at a standstill waiting for the unwatering of the mine by the drainage tunnel that is being driven.

The ore of the Guillermina mine differs from the rest of the ores that are now being worked in that it is essentially silver. The highest-grade ores consist of tetrahedrite associated with rhodochrosite and rhodonite. Quartz is also a prominent gangue mineral. Galena, sphalerite, chalcopyrite and pyrite occur in subordinate amounts. Where sphalerite is prominent, the silver values are usually low.

The orebodies consist of a series of flat lenticular masses having a maximum width of 3 to 4 ft., formed by the replacement of limestone at its contact with an underlying porphyry. The contact has a general north-south strike and dip of about 40° to the west, and the igneous rock is probably a sill that has been injected into the limestone series. At the contact the foot-wall porphyry has been decomposed to a soft, gougey material. The effects of oxidation along the contact are evidenced in the ores to a depth of 300 ft.

At several places narrow veins were seen in the porphyry with the same minerals that the replacement ores show, and at one point such a vein spread out at the contact into a *manto* in the limestone, suggesting that veins of this sort were the channels by which the mineralizing solutions gained access to the limestone.

The orebody at the Gertrudis is a replacement vein in limestone with enlargements along certain bedding planes, similar to that of the Ombla mine, described in more detail farther on. The ore consists chiefly of pyrite and quartz, with chalcopyrite the principal copper mineral and tetrahedrite next in importance. A very little sphalerite is also present.

Mines of the Backus & Johnston Company

The mines which are next described are those worked by the Backus & Johnston company. The Isabel is furnishing the largest tonnage. The principal ore mineral is tetrahedrite, with chalcopyrite second in importance, and enargite present in but small quantity. Pyrite and quartz are the most abundant minerals. The orebody is a replacement vein in limestone with a strike of 20° W. and a dip of 55° SW. Overlying the limestone is a peridotite bed at which the vein terminates by spreading out into a broad *manto*, 20 ft. thick, the limits of which have not yet been determined, but which has been worked

for a distance of 60 ft. along the strike of the vein and 100 ft. at right angles to it. The dip of the contact is 35°. To a depth of about 50 ft. below the *manto* at intervals of about 10 ft., there are enlargements of the vein on the hanging-wall side through the replacement parallel to the bedding of 1- to 3-ft. thicknesses of limestone for distances of as much as 30 ft. away from the vein. These relations, which afford excellent examples of the effects of the damming of the mineralizing solutions by the peridotite, are shown in the right-hand sketch on p. 890.

The Ombla mine is working a replacement vein in limestone with an east-west strike and nearly vertical dip, and cuts a series of limestones with a strike at right angles and a dip of 40° to the west. The vein has an average width of about 4 ft., but shows local enlargements resulting from a more extensive replacement of certain beds of the limestone in which the ore preserves distinctly the original bedding of the rock. These enlargements include thicknesses of strata of 10 to 12 ft., and usually extend about 15 ft. beyond the walls of the vein; sometimes they occur on one side only and at other times on both sides of the vein, and in extreme cases extend out as far as 50 ft. beyond the vein. The principal copper mineral is chalcopyrite, but some bornite is also present here. In addition, there occur pyrite, quartz, sphalerite and a little galena. Because of an increase in quantity of chalcopyrite and bornite the grade of the ore of this mine with an added depth of 120 ft. has exhibited a marked increase in copper content.

The Churruca is the only opencut mine in the district, and the orebody is a large, irregular replacement in limestone. The chief ore mineral is chalcopyrite with which is associated much pyrite. In the upper part of the orebody are small pockets of tetrahedrite and enargite.

The richest zinc ore of the district is produced by the Victoria mine, the ores of which contain as much as 25% zinc.

The Santa Clara group of mines includes the Manuelita, Maria and Minero, all of which are working veins in the porphyry that carry an appreciable zinc content. Tetrahedrite is the important ore mineral and there is very little enargite present.

The Independent Mines of the District

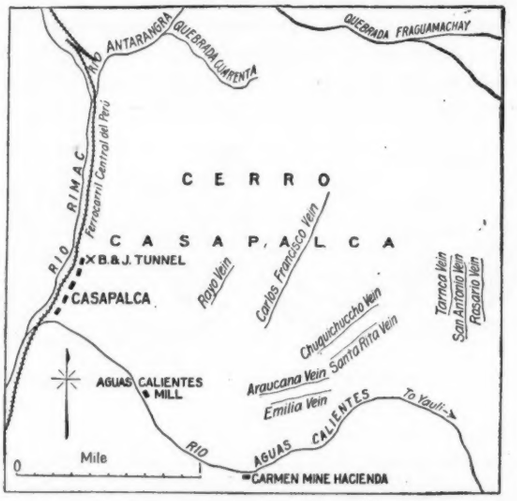
In addition to the mines already described, there are two important independent producers—La Huillca group and the Alexandria. The former works veins of the same character as those in the Santa Clara group, except that they carry a little more zinc. The latter, which is owned by Marcionelli & Hansa, is working the continuation of the vein on which the Gertrudis mine is located, and the ore is of the same character except that it carries much sphalerite and also a little rhodochrosite.

The Morococha district is undoubtedly in the early stages of a great development. Three crosscut tunnels are being driven to open up new ground and to do away with pumping in the mines. The Morococha Mining Co. is driving a tunnel from Tuctu under Lake Morococha at a depth of 395 ft. below its level to unwater the San Francisco and Natividad mines. This tunnel, which has a length of over 4,000 ft., has probably been finished by this time, as it was estimated last October that its completion would require but two months' work. Close to the portal of this tunnel and at the same level, the Backus & Johnston company is driving a tunnel that will have a length of over 4,500 ft. to develop the deeper ground of the Ombla, Gertrudis and Alexandria mines. The same company is running a third tunnel from Tuctu to unwater the Santa Clara group and La Huillca mines. The completion of these tunnels will make possible the production of a much larger tonnage in the district.

The hydro-electric plants of the Cerro de Pasco Mining Co. and the Backus & Johnston company furnish ample power and have enabled the installation of machine drills and other modern mining machinery. As a result working costs have been considerably reduced and large tonnages of ore made available that formerly were of too low grade to work.

The Casapalca District

At Casapalca, on the main line of the Ferrocarril Central del Perú, about 145 km. from Lima, is the Backus & Johnston company's smeltery and concentrating plant. Here are treated the ores from the near-by mines of the company, those from the company's Morococha mines and a certain amount of purchased ores. The following account of the district is based to a large extent on infor-



MAP OF ACTIVE PART OF CASAPALCA DISTRICT, SHOWING PRINCIPAL MINES

mation obtained in the course of a conversation with Joseph A. Irving, superintendent of the Carlos Francisco mine.

The present mining activity centers on the Cerro Casapalca, a mountain rising above the town on the east from an elevation of 13,600 ft. at the smeltery to over 17,000 ft. at its summit. The most important producer is the Carlos Francisco mine. Other producing mines are the Aguas Calientes, Carmen and San Antonio, and the Chuquichuccho and Santa Rita are being developed and should soon reach the producing stage. The situations of these mines are given on the above map. The orebodies are for the most part veins in andesite, but some extend beyond the igneous rock into the limestone which it intrudes. The Carlos Francisco mine has a monthly crude-ore output of 6,000 tons, which it is planned to increase to 10,000 tons. The average grade of the crude ore is 25 to 30 oz. Ag, and 1¼ to 1½% Cu. This tonnage is obtained from the ore in place and by reworking the upper dumps of the mine. The crude ore is screened and the fines sent direct to the smeltery. The coarse product is then hand-jigged and the concentrates likewise smelted.

The tailings of the hand jigs are treated in the 120-ton mill and concentrated in the ratio of 3½ to 1. The total product that goes to the smelter aggregates 3,000 tons monthly and averages 40 oz. Ag, 2% Cu, 5% Pb, 13% Zn, 5 to 10% Fe and 20% SiO_2.

The principal vein of the mine is the Carlos Francisco, which is cut by a tunnel one mile long from Casapalca, at a distance of 2,700 ft. below the outcrop, which at the time the tunnel was driven was at a depth of 1,700 ft. below the lowest workings. About halfway in, this tunnel cuts a vein known as the Rayo, but no work is being done on it. An aërial tram 2 km. long connects the plant with the upper workings, 2,000 ft. above the tunnel level. The strike of the vein is nearly north-south and it dips to the west at an angle of 60°. Though it pinches to a width of 1 ft. or less and swells to as much as 12 ft., the average width of 2½ ft. is maintained. For a distance of about 2 km. along the strike the country rock is a silicified andesite, but at each end the vein passes out into limestone. The present operations are confined to the vein in the andesite.

The most abundant minerals in the vein filling are quartz and pyrite, with tetrahedrite the valuable constituent. There is little chalcopyrite present, and galena and sphalerite are not abundant. The ratio of silver to copper in the ore shows a gradual decrease with increasing depth, so that, whereas in the upper levels this ratio was 1 : 20, in the low levels it is only 1 : 30.

The fact that this vein has been developed over a horizontal distance of 2 km. and a vertical distance of 2,700 ft. without reaching its limits and that it is continuous throughout this extent with a fairly uniform width and character of filling marks it as truly a remarkable vein.

The Aguas Calientes mine is working the southern extension of the Carlos Francisco vein and sells to the Casapalca smeltery monthly 600 tons of sorted ore and mill concentrates made at its own mill, averaging 100 oz. Ag and 3½% Cu.

The monthly production of the Carmen mine is 600 tons of hand-sorted ore, of which one-fourth is first-grade, carrying 150 oz. Ag and 2% Cu, and three-fourths second-grade, carrying 50 oz. Ag and 1% Cu. It is working the Araucana and Emilia veins.

The only ore in the district with ruby silver and with sufficient gold to be paid for is that produced by the San Antonio mine. Its output is all hand-sorted and consists of about 10 tons of first-class ore with 200 oz. Ag, and 500 tons of second-class with 50 oz. Ag. and 1½% Cu.

Nevada Consolidated Copper Co.

Nevada Consolidated Copper Co., McGill, Nev., reports a total production of 24,585,393 lb. of copper for the third quarter of the year, this being divided into 8,537,231 lb. in July, 7,688,014 lb. in August and 8,360,148 lb. in September. During the quarter 1,020,546 dry tons of Nevada Consolidated ore, averaging 1.68% copper, was milled, and of the tonnage milled 84% was supplied from the pits and 16% from the underground workings of the Ruth mine. In addition, 16,775 dry tons of Giroux Consolidated Mines Co. ore was milled during the quarter.

The cost of copper produced, including Steptoe plant depreciation and all charges except ore extinguishment, and after crediting all miscellaneous earnings, was 8.67c. per lb., as compared with 8.51c. for the previous quarter. Excluding the item of depreciation the cost was 8.01c., as compared with 7.78c. for the previous quarter. The outcome is figured on copper price of 23.883c. per lb. for the quarter and 24.959c. for the first nine months of this year. No copper available for delivery remains unsold.

There was a surplus for the quarter of $1,901,740 after payment on Sept. 30 of the 27th dividend at 50c. per share and extra dividend No. 6 of 50c. per share. There was set aside $173,187 for plant and equipment depreciation and $103,205 for ore extinguishment, leaving a net balance to earned surplus for the quarter of $1,625,348 and a total balance of $11,091,045 in earned surplus.

Russian Mining Development During the War*

Charles Bogdanowich, Director of the Geological Committee of Russia, in passing through Paris, has made the following communication to the Geological Society of France on mining explorations conducted in Russia since the beginning of the war:

Before the war Russia was tributary to foreign markets, and thus we were suddenly deprived of several common minerals that had formerly come to us from Hamburg and Berlin, such as fluorite, barium ore, mica, infusorial earth, potassium salts, pyrite and ores of arsenic and antimony. Tungsten, molybdenum and vanadium, very important for the special steel industry, were likewise lacking. The ministry of defense, the industrial companies, engineers and manufacturers then requested the Geological Committee of Russia, which is a center for geological data of almost all Russia, to supply information on the deposits of these minerals at home.

Work of the Geological Committee

The Geological Committee, thanks to the work of 30 years past, was able to furnish exact and detailed information on the locations of the beds and their quality, but unfortunately they were insufficiently posted as to the quantities, for the majority of the known deposits were not worked, owing to the general commercial conditions of the country. Nevertheless this informatory work has had great success; it has led to activity both private and governmental.

At the instance of the government, the Geological Committee organized, in 1915, prospecting work followed by development of fluorite, iron pyrites, saltpeter, alunite, etc. The investigations of fluorite have been crowned with great success. The question of coal was studied near Petrograd, by request of the municipality, and the Geological Committee obtained substantial industrial results.

These works were approved by the government and the Duma. In 1916 the accrued budget of the committee was sufficient to enable its corps of geologists and engineers—more than 70 persons—to be sent into the Ural, the Caucasus and Siberia, and engage in greatly varied reconnaissances.

Numerous questions present themselves to the Russian geologists: What deposits are suited for immediate working? Which may increase their output? Which are of especial industrial interest? The question of rare metals

*Translated from the "Echo des Mines et de la Métallurgie," Paris.

interests us particularly. We have lately organized research and development of tungsten in the Ural, near Ekaterinburg, and at some points in the Transbaikal.

I would point out that in the second year of the war, at the time of industrial mobilization, when in all the Russian provinces industrial military committees were organized with the support of the government, by the efforts of representatives and delegates of industry, trade and engineering, the Geological Committee formed a part of the Central Industrial Military Committee directed by M. Poutchkoff.

The Geological Committee thus became the source of all the information on the true conditions of the various deposits, the exploitation of which had occasioned many companies to be formed. Since it often occurs in such cases that mineral values are exaggerated, an examination by the Bureau of the Central Industrial Military Committee was necessary to regulate, coördinate and direct efforts toward the same object, with minimum expense for the people and the state.

I can assure you very frankly that the geologists of our committee have taken their share of responsibility in the common work, which they execute with all the qualities demanded by science, and love of country.

Thanks to the very recent working of deposits in some cases new, I may assure my friends in France that the Russian industry can now be supplied from its own resources in the most important metals, such a copper, lead, zinc and manganese. I hope this year we shall increase our production of gold and that we shall develop the exploitation of ores of some rare metals, such as molybdenum, tungsten and arsenic. The information that the Geological Committee has gathered recently throughout Russia authorizes me to affirm that the mining prosperity of that country is assured for the future.

In spite of all this urgent work, the committee has continued its scientific studies and its systematic explorations in the oil fields of the Caucasus and Uralsk, in the Donetz coal basin and the platinum-bearing lands of the Urals without longer neglecting the gold fields of Siberia. We are fixing our attention upon the possibility of increasing the output of the gold lode deposits and that of the alluvial fields, the latter by dredging.

During the war the committee has completed the new edition of the geological map of European Russia in six sheets and finished the mineral map on the same scale, which is indispensable to the former in order to show the distribution of mineral deposits in the natural metallogenic districts. This map is about to be printed and will be completed with an explanatory text on the mineral and metalliferous deposits of all Russia.

The Russian government, represented by the Minister of Commerce and Industry, gives us powerful support and is thinking of extending the geological service considerably.

Mineral Production of British Guiana

Gold production of British Guiana, as reported by the Lands and Mines Department, for the nine months from April to December, 1915, amounted to 39,793 oz., a decrease of 12,397½ oz. from the corresponding nine months of the previous year. Of the total, 29,695 oz. came from placer washings, 9,990 oz. from dredging and the remainder from quartz mines.

Dredging was carried on in the No. 2 mining district by the Guiana Dredging Co. with four dredges in the Konawaruk River, and by the Minnehaha Development Co. with one dredge in the Minnehaha and one dredge in the Mahdia Creek.

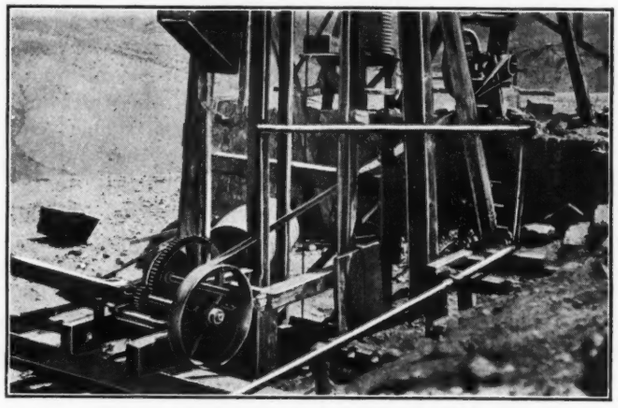
The output of diamonds during the same period was 19,461 stones, weighing 3,678¼ carats. The estimated value of these stones was $36,782.50.

Temporary Mine Pumping Plant

SANTIAGO CORRESPONDENCE

In the mining districts of Chile it is often necessary to dewater a mine in order to be in a position to drop the option. Usually this mine has only surface water in it, so that a permanent plant is not needed. No one knows of a gasoline sinker, and a steam plant means much expense and a search for fuel, because wood for fuel in the mining districts is the exception rather than the rule.

With a vertical shaft or even with a slightly inclined shaft, the ordinary deep-well pumping head has served excellently. The size of the pump and of the kerosene engine should be proportioned to the cubic contents of the flooded workings, but my suggestion is that a very



A TEMPORARY MINE-PUMP INSTALLATION IN CHILE

small plant be laid down, the time lost in pumping being devoted to some other agreeable pursuit.

Usually these old mines have the shaft in anything but good condition. This means that dewatering can go on at the same time that the shaft is being lagged with cactus and pear trees. Then if the removal of the water superinduces a cave, nothing but the end of the pipe is bent, thus saving the feelings of the pumpmen. If ingenuity equal to the correspondent's is available, it will be possible to hug the foot wall with the pipe and hoist dirt and old timbers and work on the shaft, while pumping.

In the illustration the pump replaces a horse whim and skip in an inclined shaft. The horse had been used since the mine was opened—the same horse. The bucket leaked seriously. Probably at the beginning the horse walked rapidly and the bucket did not leak. At the time I saw the equipment, the leakage overtook the horse and the bucket arrived—wet it is true, but in a condition to discourage continuous operation.

The Bisulphite Process

By An Occasional Contributor

SYNOPSIS—Process is about ten years old and is but one of many methods proposed for extracting zinc by means of sulphurous acid. In theory, zinc in ore is roasted to oxide without formation of sulphate; oxide converted to soluble bisulphite and separated from insoluble ore; soluble bisulphite converted to insoluble monosulphite by heating to boiling point, and finally converted to zinc oxide by heating in cast-iron retorts. Because of various difficulties encountered in practice, handling about three tons of ore daily, commercial success was impossible. In general, oxidation to zinc sulphate, or the direct use of sulphuric acid, is preferred.

Methods that have been proposed for the extraction of zinc from its ores and compounds, by means of sulphurous acid, are numerous. A search at the Patent Office will reveal a large number of applications dating back half a century. Many of these patent specifications merely reveal chemical absurdities; others involve mechanical conditions that are impossible on any commercial work. In general, most of the specifications indicate that the experiments, if any, which were made before the patent was applied for were purely qualitative and only on a test-tube scale.

The so-called bisulphite process is the only one dealt with in this article, and it will be considered from a metallurgical and mechanical point of view only. This process had its genesis about 10 years ago. Its object was to extract zinc (and recover it in the form of oxide suitable for the spelterman) from any complex ores or products; that is, from those raw materials that could not be handled directly by the spelterman or could not be concentrated and thereby produce a concentrate suitable for the spelterman.

Naturally, during the years that have elapsed since the process started, other improvements have taken place and the need for a bisulphite or similar process is not as great as it was. For instance, the spelterman, by mining his raw materials, will now handle products containing lead or lime (or both) that he would not have touched a few years ago. The machine-made pots used in spelter works also help considerably in handling complex charges. Advances in ore dressing now make it possible to dress up complex materials and make a good product for the spelter works. Also the residues from the spelter pots (retorts) are now commonly dressed for recovery of lead and silver. All this has made possible and acceptable to the spelterman most of the complex ores and products which a few years ago would have been refused. Hence the necessity for a process for complex zinc-lead-silver or other complex zinc ore has very largely ceased to exist.

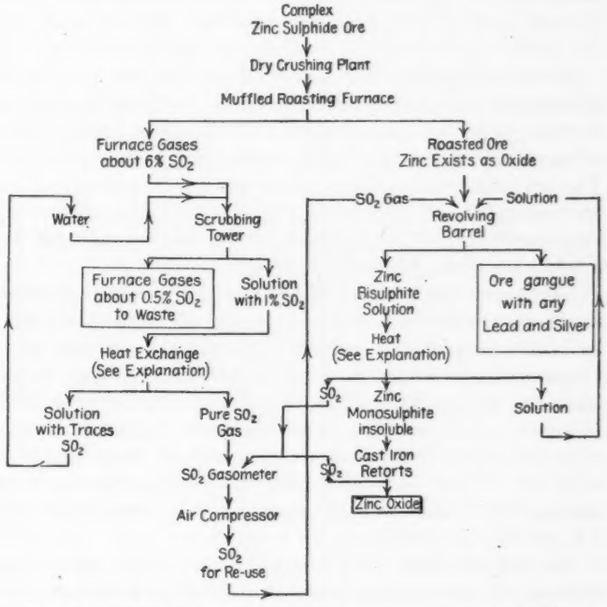
Original Form of the Process

It must be borne in mind that, however broad and foolproof any process may be, variations are demanded by different ores and for different fields of operation. The procedure as first tried about ten years ago is shown in flow sheet No. 1. This provides for roasting the ore in a muffle furnace at a finishing temperature of about 950° C. so that no zinc remains as sulphate; therefore the majority of zinc is oxide. By using a muffled furnace the gases from the ore are rich in SO_2 (sulphurous acid), say 5 to 7%. Hence, by the aid of a scrubbing tower a weak solution of SO_2 is obtained at a nominal cost; but after once starting up, since theoretically all the SO_2 used is returned to the circuit, only enough SO_2 has to be absorbed daily in the scrubbing tower to make up for losses.

Heat required for boiling the SO_2 out of the solution from the scrubbing tower or for heating the bisulphite solution (and thereby causing half the SO_2 present to be evolved as gas) was obtained by heat-exchange arrangements, by cooling the gases from the muffle furnace; that is, both the SO_2 gases and the fuel gases.

The gaseous SO_2 acting on the roasted ore in the presence of water renders all zinc, which exists as oxide, soluble in the course of two or three minutes.

As a solvent for zinc oxide, SO_2 is so desirable because it is possible to form zinc-bisulphide solutions containing



FLOW SHEET NO. 1, SHOWING ORIGINAL BISULPHITE PROCESS

about 8% zinc, and these solutions on being raised to the boiling point under favorable conditions for the evolution of SO_2 give off half of the SO_2 as pure gas and deposit as insoluble zinc monosulphite about 90% of their zinc contents. This insoluble zinc monosulphite is heated in cast-iron retorts, yielding zinc oxide and SO_2 gas that, like the SO_2 from heating the bisulphite solution, is used again on a new lot of roasted ore. The zinc oxide is heavy, free from traces of lead or silver and makes first-grade spelter. The ore residue, after the extraction of all the SO_2-soluble zinc, contains all the lead and silver—in fact, everything except zinc—and in a concentrated form due to removal of zinc and consequent loss of weight.

Obviously, to suit this procedure the ore must have high sulphur contents to aid the muffle roasting and must not be too high in lead or the high temperature of the finishing

roast will cause sintering. Ores with much lime or magnesia are not desirable, as these materials consume SO_2. The lime and magnesia will eventually appear with the final zinc oxide, as sulphate of lime is very soluble in SO_2 solution.

The defects in the procedure outlined in flow sheet No. 1 were so numerous that the process had to be abandoned. The high temperature of the finishing roast in the muffle-roasting furnace causes zinc to combine with iron oxide and thereby produce zinc compounds which do not yield their zinc to the acid solvent. This is a vital defect and has caused a large amount of work. It is true, there are complex zinc ores so low in iron or manganese that a high-temperature roast does not cause decrease in zinc solubility, but such ores are the exception. Muffle roasting of zinc ores is not too simple or low in working cost, especially when the sulphur contents fall low.

The originators of the procedure thought that, having endeavored to guard against the formation of sulphate of zinc both in the ore and in the solutions, practically all the zinc would be in the form of bisulphite and would be recovered as zinc monosulphite by heating the bisulphite solution. This is not so. There will be some zinc sulphate in the ore when the roast is finished, and the solutions in being handled by pumps will gradually oxidize to sulphate. No satisfactory plan was provided for dealing with this ever-growing quantity of sulphate of zinc in solution.

No air compressor was found of any use for any length of time for pumping the SO_2 gas into the revolving barrel. Various types of compressors were used, including those of the diaphragm type, but in the long run they all failed. The maintenance cost was much too great, and this alone was enough to shut down the work. All pipes conveying zinc-bisulphite solution gradually blocked up through the zinc monosulphite crystallizing out.

In general the smell of the SO_2 was so great that, after using all possible precautions, even if all other conditions had been correct, the original procedure could not have continued. Solutions had to be handled in large quantities by pumps, and these solutions contained over 10% of loosely combined SO_2. As a matter of fact, if a solution contains about 1% of loosely combined SO_2 (that is, attached to zinc as bisulphite), it is impossible to stand near a small tank into which only a 1-in. stream of such 1% solution is running.

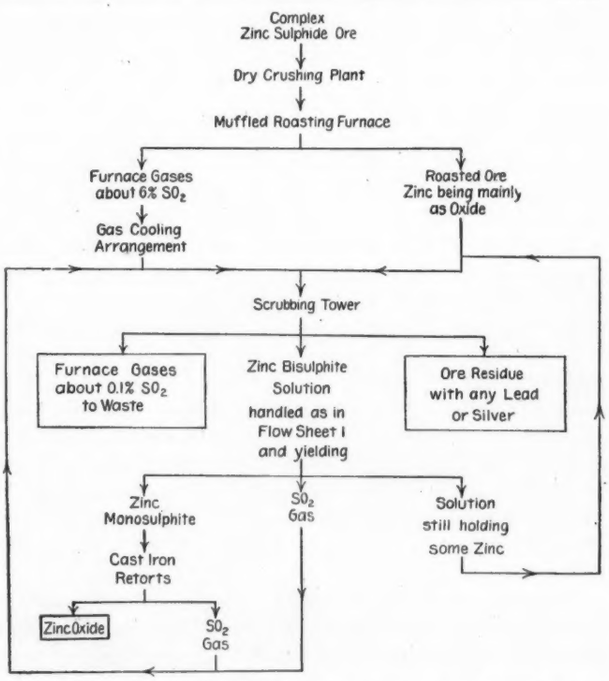
All construction and maintenance costs were high because all pipes were lead, all valves were either antimonial lead or some special brass, all tanks were lead-lined, and because all iron work had to be protected continually, the atmosphere being moist and always with traces and sometimes with large amounts of SO_2 in it.

The net result of the work, as here roughly outlined, was that no further attempt was made to use SO_2 as gas. This work had been carried out on a scale of up to about three tons per day, and the decision to abandon the use of SO_2 as gas was not arrived at till most exhaustive work had been carried out and till it was evident that commercial success was impossible, one of the principal (of the many) difficulties being that almost every tank or vessel had to be covered air-tight, therefore no operation could be easily watched or controlled.

Modification of the Process

The next procedure used is shown in flow sheet No. 2. At first sight it had many advantages, and although some objections were obvious, no vital objections appeared till the procedure was put into operation. The partly-cooled sulphur gases from the roasting furnace were passed up a scrubbing tower, down which there was fed roasted ore with water or solution from which the bulk of the zinc had been removed.

When water alone is run down a scrubbing tower, only a 1% (or less) solution of SO_2 can be obtained; but when the water also conveys zinc oxide (that is, roasted ore) which combines *chemically* with the SO_2 then a greater percentage of SO_2 can be caught, equal approximately to the percentage in the original furnace gases, in this case usually from 5 to 6%; therefore in the case of ore and water (or solution) together running down the scrubbing tower, the final solution will contain at least six times as much SO_2 as is the case when water alone is used to absorb the SO_2. It was realized that probably in spite of the efficiency of the contact arrangements in the scrubbing tower, the descending stream of ore and solution which flowed counter to the rising gas might at times leave the



FLOW SHEET NO. 2, SHOWING MODIFICATION OF BISULPHITE PROCESS

scrubbing tower with still an important percentage of zinc undissolved; that is, which had not yet met SO_2. It was therefore arranged to run two scrubbing towers in series, and the stream of ore and solution leaving the last scrubbing tower was to be elevated to the top of the *first* scrubbing tower (the one *nearer* the furnace); and thus the ore with most zinc in it would meet the weaker SO_2 gases, and after most of the zinc had been dissolved, the ore and solution would be elevated to meet the strong SO_2 gases (which had just left the furnace) during their passage up the first scrubbing tower.

The ore and solution, after finally leaving the scrubbing towers, was collected in tanks, washed, and the solutions separated much the same as in cyanide work. At first the method of precipitation consisted in heating bisulphite solutions to near the boiling point so that half the SO_2 was liberated and about half the zinc, on cooling, was precipitated as an insoluble monosulphite of zinc ($ZnSO_3 \, xH_2O$). Heating to about 600° C. converted the latter

compound to zinc oxide. The heating of this solution was carried out by waste heat, by steam through coils, by injecting live steam into the solution or by running the solution cascade-fashion down a short tower up which the combustion gases from a coke fire were drawn, necessary structural arrangements being made to discharge the boiling solution at the bottom, clear of the firebox.

All precipitation by means of heat was found to be greatly improved if a small calculated quantity of zinc oxide or calamine was added when most of the bisulphite had been decomposed. Finally, after a large amount of experimental work, it was found that the only positive method of precipitation suitable for the case in question was to work the solutions up in zinc contents till they contain 10% or more of zinc as metal and then evaporate them to dryness; that is, until on cooling the whole mass consisted of $ZnSO_4{,}7H_2O$ (ordinary sulphate of zinc) crystals.

As regards the dissolving of the zinc from the ore as outlined in flow sheet No. 2. It will be seen that there flows down a scrubbing tower a mixture of ore and solution and that this mixture flows counter to a rising current of gas. The ore and solution is fed in at the top at a fixed but variable rate by mechanical means. If *too little* ore is fed into the top of the scrubbing tower, then this ore on issuing at the bottom will have all its zinc converted into bisulphite, a considerable quantity of SO_2 will escape to waste at the top of the tower and there will soon be a shortage of SO_2. Conversely, if enough ore is fed to scrubbing tower so that practically no SO_2 goes to waste, then the ore coming out at the bottom of the tower will still contain much undissolved zinc. Because both the rate of flow of the SO_2 gas from the furnaces per unit of time and the percentage of SO_2 are continually changing, it is not possible to feed in ore at a rate so that not only is practically all the zinc converted into bisulphite, but also no SO_2 goes to waste (that is, is not neutralized by zinc oxide). For this reason the method in flow sheet No. 2 could not succeed commercially.

General Difficulties of the Process

The general difficulties that seem to be connected with any commercial method for extracting zinc by means of sulphurous acid are briefly covered by the following statements.

The main reactions of the process are:

$ZnO + SO_2 + xH_2O = ZnSO_3xH_2O$ (zinc monosulphite)

$ZnSO_3xH_2O + SO_2 + H_2O = Zn(HSO_3)_2 + xH_2O$

When boiled, in solution, $Zn(HSO_3)_2$ yields $ZnSO_3 + SO_2 + H_2O$. At about 600° C. $ZnSO_3$ yields $ZnO + SO_2$. When formed by action of SO_2 on ZnO in presence of just about enough water required for the water of crystallization (which is really about $5H_2O$), $ZnSO_3xH_2O$ swells to about three times the volume occupied by the original ZnO. *Thus, in any case where $ZnSO_3$ is formed in the roasted ore, if there is not enough water present to dissolve it all, there is a great increase in volume.*

The solubility of $ZnSO_3$ in cold water, normally about 0.5%, is decreased by the presence of zinc oxide. In the presence of water $ZnSO_3$ is easily converted by SO_2 into zinc bisulphite, a compound which only exists in solution, but which is very soluble in water. A solution containing about 10% of zinc as bisulphite can be easily prepared. Zinc-bisulphite solutions gradually deposit $ZnSO_3$ by evolution of SO_2.

Zinc monosulphite ($ZnSO_3xH_2O$) is a crystalline compound and sets to a hard compact mass which cannot easily be broken up even with a pick ax or drill. Similarly any roasted ore containing zinc, if treated with enough SO_2 to form $ZnSO_3$ and allowed to settle for a short time, will set to a hard compact mass which is as hard as "set plaster of paris." The facility with which this $ZnSO_3$ sets hard is a point of great difficulty in commercial work.

Both in solution and in the solid state $ZnSO_3$ oxidizes rapidly to zinc sulphate. The same remark applies to the bisulphite solution; but in either case it is difficult, by atmospheric oxidation only, to convert *all* the zinc into sulphate.

The sulphur gases from the roasting furnaces leave the furnace at a temperature of from anything down to, say, 250° C. These gases cannot be brought into contact with ore and water in order to form zinc bisulphite, unless their temperature has been lowered sufficiently so that the mixture of ore and water will not be raised much above atmospheric temperature. If a mixture of ore and water be heated appreciably by the gases, then zinc bisulphite will be decomposed or not formed at all, and instead of the zinc oxide being made into the soluble bisulphite, it will remain with the ore as the almost insoluble monosulphite. This is important and brings up the question of cooling the sulphur gases.

The roasting of a complex ore is not by any means too simple an operation. In addition to zinc, lead and silver, such an ore may contain also iron, silica, copper, arsenic, antimony, etc. In general if an ore is roasted at such a temperature that practically none of the zinc remains as sulphate, then it will be found that a large percentage of the zinc present is *not* soluble in SO_2. Conversely, if roasted at a temperature very gradually rising up to but not above 650° C., then 90 to 95% of the zinc contents will be soluble in SO_2. (It is in general assumed that such ores contain about 25 to 30% of zinc.) In the foregoing case of low-temperature roasting, from 30 to nearly 50% of the zinc will be as sulphate after the roast and would therefore be soluble without any SO_2. With this low-temperature roasting, some iron will probably be water-soluble or SO_2-soluble.

In furnaces, zinc sulphate in ores is broken up into ZnO, etc., at a much lower temperature than is stated in textbooks. The conversion of $ZnSO_3xH_2O$ to ZnO can be accomplished by roasting in a reverberatory furnace better than in a muffle furnace. It might be expected that almost all would be converted into sulphate, but such is not the case. The higher the temperature to which any ore is heated during the roasting, the less readily is the ZnO dissolved by SO_2.

Complex ores containing, say, 25% zinc and as little as 8% lead, if roasted at a finishing temperature of about 850° C., will be found to have some of the ZnO mechanically protected by a glaze, presumably of lead sulphate or silicate. This mechanical occlusion of the ZnO increases with the percentage of lead present and with the temperature of the roast.

Many different makes of pumps could be used for elevating zinc-bisulphite solution, but none was found to be commercially successful in elevating ore and solution. This was one reason why ore and solution leaving one scrubbing tower could not be elevated so as to pass down another one. In this connection air-lifts failed principally on account of the setting properties of zinc monosulphite.

With reference to a complex zinc-lead-silver ore containing, for example, zinc 30%, lead 10% and silver 10 oz. per ton, if, say, 84% of the zinc is extracted, then 5 units remain in the residue. But one ton of ore, after roasting and extraction of the zinc, will have lost about half its weight and 5 units of zinc will be in half a ton. The residue will assay zinc 10%, lead 20%, silver 20 oz. per ton; therefore whatever zinc is not extracted will figure more prominently as a penalty in the residue.

Sulphuric acid causes silica to pass into solution, but SO_2 does not have this effect. When silica does pass into solution, it may appear later as gelatinous silica, if for any reason the solution becomes neutral.

Traces of copper, arsenic, etc., should be removed from all bisulphite solutions before they are heated to precipitate the zinc monosulphite. The quantity of copper present may be of value, but the arsenic, antimony, etc., should be kept away from the final zinc oxide. Zinc dust is the best agent to use for this purpose.

Some General Conclusions

Sulphurous acid can be of no utility as a solvent for zinc oxide from ores except in those localities where it is cheaper to use it on the lines indicated than to buy sulphuric acid. It is a question of geography and freights—this is important; it does not necessarily mean that, even if the ore in question is mined in quantity, it may not pay better to bring it to where acid can be bought.

If sulphurous acid (SO_2) is used as resulting from the roasting of complex zinc ores, it may be possible to attain commercial success by roasting the ore so as to produce the maximum amount of water-soluble zinc sulphate and at the same time a good percentage of the remaining zinc as soluble in SO_2 (or H_2SO_4). The portion of the zinc that is dissolved by SO_2 will yield a bisulphite solution. This solution by aëration should be oxidized to sulphate; thus all the zinc in solution will be sulphate. The neutral solutions after purification by zinc dust can be worked up in zinc contents so that a certain daily portion of the solution assaying about 10% zinc will be evaporated till the density shows that there is practically nothing but sulphate of zinc melted in its own water of crystallization. The cooled mass will solidify, and it can be roasted in a reverberatory furnace to produce zinc oxide.

If a wet method is required for any zinc ore, from a metallurgical point of view sulphuric acid will do as well as SO_2.

The question of the electrolytic precipitation of zinc from the sulphate solutions as an alternative to evaporation has been omitted purposely in this article.

False Returns On Ores that are sent in for smelting and treatment, is a fear that seems prevalent among men operating small properties in Arizona. The Arizona State Bureau of Mines has conducted an investigation and has found that it would be utterly impracticable for any smelter or mill to so falsify its method of sampling as to give low returns and still give the shipper one half of the sample to allow check assays to be made. Bulletin No. 26 of the bureau (entitled "Mill and Smelter Sampling," by H. J. Stander) was written to show the small shipper how to sample his ores before shipment, thereby having a check on the smelters. Smelter methods are given in detail, so that the reader may determine whether, owing to the number of men who would be concerned in any falsifying system, the smelters could afford to give incorrect returns. When the Copper Queen mine, for instance ships to the Copper Queen smelter, the smelter purchases the ore precisely the same as they do the ore of the man who ships ten tons, and the sampling and umpires are done under the same conditions.

Miners' Phthisis Prevention

By A. Cooper Key*

From time to time the miners' phthisis prevention committee, formed to report upon the methods for prevention of miners' phthisis in Rand mines, has issued interim reports, and it has now published a complete statement dealing with work accomplished in the four years since its creation. Dust sampling was begun in March, 1912, and over 2,800 samples were taken to the end of that year. The work of the committee has been largely centered on carrying out numerous experiments to determine the quantity and nature of dust, the best methods of preventing its formation and laying it when it cannot be prevented and of safeguarding miners against its inhalation. Attention has been paid to medical-research work. Many inventions, patents and suggestions from various sources have been examined and tested.

Experiments, analyses and other investigations have necessarily occupied a great deal of time, and although much valuable knowledge has been gained, much still remains to be done, and the investigations of the committee are still proceeding.

Nature and Relations of the Disease

The second chapter deals with the nature and general relations of the disease. It begins as a silicosis, which is not intrinsically an infective process. It is a condition of fibroid change in the lung, caused by mechanical irritation of the tissues, arising from the presence in the substance of the lung of very fine siliceous particles derived from dust-laden atmosphere which the miner breathes. The lung is rendered more liable to intercurrent invasions by infective processes, especially tuberculosis, which usually increases in proportion to the degree of silicosis. The majority of early cases have not this complication, and in many cases, if the affected man leave underground work, he may remain free of tuberculosis practically indefinitely. On the other hand, if underground work be continued, tuberculosis will in most cases sooner or later supervene. Although the term "silicosis" accurately defines the constant and occupational factor in the disease, the more general term, "miners' phthisis," describes better the composite character ultimately assumed. In the report an explanation is given of the general rôle which these two factors, silicosis and miners' phthisis, played in the development of the disease.

Nature's Protective Mechanism

It is also explained that the air passages, the wind pipe, bronchi and bronchial tubes, with their cilia, provide a protective mechanism against the entry of foreign particles. Much of the dust that is inhaled is entangled on the moist surfaces of the nose and throat, and if not present in an overwhelming amount, the portion of it which reaches the bronchial tubes is gradually worked upward and expelled. With dust in large quantities, the protective mechanism breaks down, many especially of the finer particles pass the protective barriers and gain access to the air vesicles. It is most important for those employed underground to keep the protective mechanism in a state of efficiency. Exercise in the open air after working hours is to be strongly recommended. Simple breathing exercises will also help greatly to maintain the normal power

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of chest expansion, stimulate circulation in the lungs and promote the healthy activity of the whole breathing mechanism. Dust will be got rid of that otherwise would have remained behind to do further damage. A regular annual holiday away from the influences of underground work is a very important preventive measure.

Although detailed knowledge of the disease has been considerably extended in the past few years, the committee expresses the opinion that all recent pathological work has gone to confirm the general accuracy of the view of the origin and nature of miners' phthisis on which the work of the committee is based. Further observation is, however, necessary before the pathology of the disease can be elucidated, and in addition, experimental investigation is required. An investigation into rat silicosis is now proceeding and promises to give useful results, the rat having a high natural immunity to tuberculosis. Some amount of throwing off siliceous and pigmented particles from a silicotic lung takes place, but this clearing is not in itself capable of bringing about a restoration of those portions of the lung already seriously damaged, although the injury may to some extent be compensated for. In the committee's opinion it is never safe for a man who has once contracted a definite silicosis to resume underground work even though his health in a surface occupation may have become quite good, and his working capacity be little, if at all, impaired.

Pure tuberculosis of the lungs unaccompanied by silicosis occurred to a certain extent among underground workers, particularly in the earlier years of their mining life. Such sufferers may obviously become quite incapacitated, but they are not legally entitled to compensation under the act. This fact has, in individual cases, given rise to some amount of apparent hardship, the reason for which is not, the committee believes, generally understood among miners.

Broad Policy of Prevention

Radiographic appearances in miners' phthisis afford the most reliable single evidence in establishing the existence and stage of the disease. But a complete opinion must be based both on X-ray appearances and clinical examination. The broad policy of prevention must (a) prevent the formation and dissemination of dust and, where this is impossible, protect men from inhaling dust and explosives fumes; (b) protect workmen against risk of infection by tuberculosis. A further important preventive measure is the adoption of a strict system of selection of recruits for underground employment. Men should have good physique and reserve of respiratory capacity. The economic wisdom of accepting men over 45 years of age for initial underground work is doubtful. All persons with tubercular taint, even if latent, should be rigorously excluded.

Preventing Dust and Laying It

In the chapter describing methods of laying dust and preventing its formation or inhalation, it is stated that when it is considered that the most dangerous particles have a diameter of $^1/_{25000}$ in. and that to catch all the dust in sampling so dense a medium as sugar has to be used, it is clear that no respirator can be devised which will prevent passage of all dust and at the same time allow of breathing. The question of electrical blasting was closely investigated at the Meyer & Charlton; while this method has undoubted advantages, its general application at present is not practicable. Its field of usefulness appears to be limited to circumstances where it is impossible to remove men from the fumes and dust of blasting by the ordinary method of fuse firing. After thorough investigation of all possible ways and means, the conclusion is arrived at that abundance of clean water, judiciously used, is generally the most satisfactory medium at present known for dealing with dust. Special liquids, while showing no definite superiority over plain water in extracting dust, retained the dust after deposition better than water does.

The report deals at length with the most suitable methods of laying the dust produced. The latest types of water-blasts, jets, sprays and atomizers are described and illustrated. They are the result of much experiment on the part of the mines and the committee and may be looked upon as the most tangible and practical fruits of their labors. It is only possible here to give an outline. The water blast should be brought into action by the miner in charge immediately after lighting up and should be placed at a sufficient distance from the face to obviate injury from the explosion, while being at the same time near enough to lay dust and fumes at the point of origin. In the few cases where "cut and round" blasting on one shift is permitted, the use of two water blasts is advisable. In blasting in large open workings such as stopes, the use of water blasts is impracticable and ineffective. The reduction in quantity of dust obtained by the use of experimental devices was never such that the air could be considered sufficiently purified. The only way of coping with this difficulty is to sweep out such air as rapidly as possible by means of the ventilating current. Blasting, either in the solid, in large loose rocks or in order to release box holes or ore passes, should only in cases of absolute necessity be allowed during the shift, in view of the huge quantities of dust and deleterious gases released by blasting. All persons not directly employed in blasting should, as far as possible, leave the mine before blasting begins. This removal is facilitated by the practice on several mines of sending down men not actually employed in breaking ground earlier in the shift and hauling them to the surface before the beginning of blasting. Proper control and regulation of blasting conditions and hours is of most vital importance.

Precautions in Machine and Hand Drilling

In machine drilling wet drilling is now obligatory and may be considered the normal condition. In collaring, large quantities of water are necessary. When drilling with machines other than water-feed, the jet should be unscrewed from the hose and the collar deluged until the hole is well started, when the machine should be stopped, the jet screwed to the hose and inserted in the hole and kept there. Spraying water around and across the mouth of a hole is unsatisfactory. Detailed results are shown as regards different drills. In hand drilling care should be taken that the surrounding surfaces of rock are kept well wetted during collaring. Water should be poured in from time to time as soon as the hole is of sufficient depth to retain it; a wet swab should be used throughout. No rock should be moved or handled in any part of a mine until it has been thoroughly wetted by means of a hose attached to the supply pipe. Suitable devices should be installed throughout main airways and traveling roads, in conjunction with the general wetting of surfaces in stopes and development ends and off the broken rock.

Experiments in laying dust by electrical means were tried in the lines of arrangements in the United States cement factories, but there does not appear to be any means of practically applying the method in mines in which conditions are so greatly different. Surfaces wet with Belger fluid retain their wetness for a long period, the dust accumulating on it, but always presenting a damp surface. Its use, however, is limited to airways where the air is below the point of saturation, since wet air causes the deposit to liquefy and run. In tunnels, stopes, etc., where continual watering or spraying is necessary, the Belger fluid would, with occasional reapplication, serve a useful purpose.

The report goes on to treat of dust in crusher stations, the air in which can easily be dealt with if reasonable precautions are taken. Good results depend entirely upon the adequacy of spraying arrangements and the system of exhaust ventilation. While silicosis is negligible among assayers, it undoubtedly exists among crusher-station men. A further lengthy chapter discusses ventilation. It would be an advantage to cut out old stopes from air circulation, where possible, so as to increase the amount of fresh air in places where it is wanted, and it would also be an advantage to have a special official to look after the ventilation and water service, instead of distributing the duty among a number of persons. Special attention must be paid to ventilation of close places.

How Far Have the Measures Been Effective?

The question as to how far the measures already taken to reduce the amount of dust present in the air of mines had had beneficial results could not be fully answered by reference to statistics. The disease was so insiduous and in the earlier stages the diagnosis was so difficult and uncertain that it must be some years before actual facts based on figures could be arrived at.

While it was impossible to base a statement regarding the amount of dust in the air of mines on individual samples, it could be confidently stated that the information derived from the investigation so far carried out pointed to the conclusion that conditions underground had greatly improved since the inception of the committee in 1912, when the general use of water for dust laying was inaugurated. The adoption of proper and readily applied methods of dust laying and of precautions in avoiding the inhalation of air charged with dust after blasting had led and would continue to lead in the incidence of miners' phthisis. Other factors which should conduce materially toward the same end were the extension of the practice of working only one shift per day underground and the provision of an annual holiday to miners.

The committee finds it necessary to utter a grave note of warning. Sustained efforts on the part of all concerned are imperatively necessary. While the mines generally are equipped with water and necessary appliances, there are still too many cases of carelessness and lack of proper precautions in using these appliances. This is particularly the case with natives who are ten times as numerous as the white workers, and who, owing to the discomfort caused by the use of water and the slight additional effort required, were inclined to neglect precautions when not watched. The legal and moral responsibility is a joint one falling equally on employers and workmen. The management of the mine is responsible for the provision, maintenance and continued supervision of an adequate water supply and of efficient appliances. On the workman falls the responsibility of putting these appliances in use in all cases where their employment is called for.

To the report are annexed 150 pages of appendixes, including many microphotographs, drawings, diagrams and other illustrations.

Zinc Mines of Tonkin

Zinc is the leading metal produced in French Indo-China. During the past five years the exportation of zinc ore from Haiphong has averaged nearly 27,000 tons per year, according to a communication from Consul L. P. Briggs, Saigon, French Indo-China, in a recent issue of the *Commerce Reports* of the Department of Commerce.

Although some zinc has been mined in Annam and this mineral undoubtedly exists in the interior protectorate of Laos, practically all that is now produced in French Indo-China comes from the protectorate of Tonkin and is exported from the port of Haiphong. The zinc mines exploited at present occupy a strip about 50 mi. wide and 100 mi. long just above the delta district, a little north and a little east of the center of the protectorate. There are four well-defined zinc regions.

The Four Zinc Regions

The oldest zinc region of Tonkin is the Tuyen-Quang district near the town of the same name at the junction of the Clear and Gam Rivers. The ore from this group is carried in river steamers down the Clear and Red (Rouge) Rivers and through the canals to Haiphong.

Next in age and in recent years the most productive district is the Thai-Nguyen region above the town of this name on the Song Cau about 50 mi. east of Tuyen-Quang. This is the most extensive district, and it is situated near the center of the Tonkin zinc fields as they are at present exploited. The ore from these mines is floated in sampans down to Dap Cau, nearly 100 mi., then transferred to river steamers.

On the extreme east is the Than-Moi, or Langson, region on the upper waters of the Song Thuong and along the railway between Phu-lang-thuong and Langson. The ore from this region is transported by rail to Phu-lang-thuong, where it is loaded on river steamers.

The newest and perhaps the richest of these regions is the Chodien or Bac-kan district, east of the Song Gam, about 50 mi. above Tuyen-Quang. The ore from the Chodien mines is carried by a private railway to the Song Gam, then by sampans to Tuyen-Quang, whence it is transferred to river steamers.

These four regions include about 30 zinc concessions, of which only 11 are at present in process of exploitation.

Development of the Tonkin Zinc Industry

Although the Chinese are known to have obtained zinc from Tonkin before the French occupation, the serious exploitation of this mineral dates from 1906. In this year some coolies working on the estate of Commandant Cadars at Trang-da opposite Tuyen-Quang, discovered a vein of zinc ore. Further search proved the mountain to be rich in this mineral. Lacking the necessary capital and experience, M. Cadars formed the Société des Mines de Trang-da, with a capital of 300,000 francs ($58,000) and with its headquarters at Tuyen-Quang (later changed to 35 Rue de Clichy, Paris), for the exploitation of the first zinc mine of Tonkin. The first year this mine produced about 2,500 tons of ore. In 1909 the production had reached

8,000 tons, and since that date the annual output of this mine has remained at about 10,000 tons.

The discovery of zinc at Trang-da led to the exploitation of the old Chinese mines at Lang-hit, near Thai-Nguyen. Several mines—Lucie, Georgette, Renee, Metis, Bac-lao and Moba—were developed, and in 1909 M. Marcel Pierron, backed by the German firm of Speidel & Co., formed the Société Miniére du Tonkin, with a capital of 1,000,000 francs ($193,000) and with its main office at Haiphong (later transferred to 14 Rue Vézélay, Paris). At that time these mines produced only a few thousand tons of calamine and blende, but in 1911 their production reached 14,432 tons, and they have since held first rank among the zinc mines of Tonkin.

In 1909 also the Société Miniére de Than-moi was formed at Paris (14 Rue Vézélay) by M. Marcel Pierron, who retained 80% of the stock. Its mines are on the Song-Thuong between Phu-lang-thuong and Langson. The production of these mines has been irregular, varying from 492 tons in 1911 to 5,368 tons in 1914, but the ore is of a high grade.

In the meantime M. Cadars and others discovered three other veins near Trang-da-Kem, Con-rau and Con-rong, and in 1910 they organized for their exploitation the Société des Mines de Yenlinh, a joint-stock company with a capital of 700,000 francs and with its headquarters at Tuyen-Quang. The output of this group during the first four years averaged only about 1,100 tons per year, but in 1915 its production was about 3,000 tons, and estimates for 1916 point to about 4,000 or 5,000 tons.

The Character of the Zinc Ore

Several other concessions have been taken up in the Tuyen-Quang region; but the only other mine that has been sufficiently productive to deserve mention is that of Bac-nhung, belonging to Perrin Frères, which in 1914 produced about 450 tons of ore.

The Van-lang mines in the Thai-Nguyen group began production in 1911, although the concession was not granted until the next year. It is operated by the Société d'Exploitation des Mines de Van-lang, Hanoi. The production of this mine for the years 1912 to 1914 inclusive was, respectively, 1,800, 1,500 and 1,672 tons of blende, calamine and galena. The ore is of low grade, and the mine ceased operations after the outbreak of the war.

The Cho-dien concessions were granted in 1912, but because of the inaccessibility of the mines, actual exploitation did not begin until 1914. Here the proprietor, M. G. Bault, Hanoi, was obliged to build a railway of 35 km. (about 22 mi.) from the mines to the Song-Gam at a cost of nearly a million piasters. This railroad was not completed until July, 1914. During that year about 1,900 tons was produced. During 1915 the production of these mines reached 8,600 tons. At present the Cho-dien mines are surpassing all others, and a yield of 15,000 tons is predicted for 1916. The ore is mined in the open cut in the side of a hill, and it is said that there is 80,000 tons of 52% ore in sight. This seems to be the future zinc field of Tonkin.

The grade, and sometimes the character, of the zinc ores of Tonkin vary with the different mines and even in the same mine. The most common ores are blende and calamine (zinc sulphide and hydrous silicate). These ores range from 40 to 55% in metallic zinc. Each of the mines has a reducing plant where the ores are crushed, washed and calcined and thus concentrated to 55-80% pure zinc. This concentrate is then put up in gunny sacks for shipment and sent to Haiphong, from whence it is transshipped to Europe, and recently to Japan and America.

The following table shows the character and grade of ore produced by each of these mines in 1914 and the average market price in francs per metric ton of the product delivered at Haiphong:

Mine	Character of Ore	Metallic Zinc, %	Market Price, Francs
Trang-da	Calamine	40	60.60
Kem	Calamine	45	122.88
Bac-nhung	Calamine	52	132.22
Lang-hit	Calamine and blende	50	115.00
Van-lang	Calamine, blende and galena	45	64.05
Than-moi	Calamine and blende	56	131.93
Cho-dien	Calamine	50	115.01

Up to the present the zinc ores exploited in Tonkin have been found near the surface. Outcroppings on hillsides have been exploited by opencuts followed by means of tunnels. The principal tools used in the mines are pickaxes, shovels and Decauville cars. The reduction plants make use of the best modern machinery and are generally operated by electric power generated by steam. Electric drills and dynamite sometimes assist the laborer in following up a rich vein, but on the whole mining machinery is seldom used. This has been due to the quantities of ore near the surface, the abundance and cheapness of native hand labor, the difficulty of obtaining European skilled workmen, and lack of capital. But modern mining machinery must ultimately come to Tonkin. This is a part of the problem of the future development of these mines.

The cost of production in the Tonkin zinc mines is greatly lessened by the cheapness of labor. Tonkinese coolies receive on the average 30 to 40c. local currency (15 to 20c. U. S. currency) per day. Although neither as strong nor as intelligent as the Chinese, they are diligent, faithful and apt.

The following table shows approximately the amount (U. S. currency) received for products of the mines during the years 1912 to 1914 respectively. Statistics for 1915 are not yet available, but it is certain that the amount averaged two or three times as high as in previous years:

Mine	1912	1913	1914	Mine	1912	1913	1914
Trang-da	$173,700	$105,571	$116,688	Duc-bo	$10,133	.....	.....
Lang-hit	392,176	389,472	230,288	Bac-nhung	.....	$24,511	$11,484
Than-moi	21,230	66,585	136,258	Titania	.....	15,633	.....
Van-lang	25,283	23,160	21,230	Cho-dien	.....	.....	42,161
Yen-linh	16,405	15,440	34,586				
Clothilde-Adele	14,668	.....	.....	Total	653,595	640,372	592,695

The exportation of zinc from the port of Haiphong during the past three years has been as follows (in metric tons):

Port of Destination	1913	1914	1915	Port of Destination	1913	1914	1915
Dunkirk	12,936	4,991	.....	Hongkong	9	.....	518
Havre	.....	.....	500	Japan	.....	.....	7,089
Marseilles	.....	.....	17,403	United States	.....	.....	7,825
Antwerp	13,706	14,571	.....				
Hamburg	1,021	.....	.....	Total	27,732	19,562	33,335

The chief drawback of the economic system of French Indo-China has been the lack of a loan and discount bank which could advance money to a worthy enterprise. The consequences have been that many of the firms formed to exploit the mines were backed by foreign capitalists, who held stock in these firms, advanced them money and carried their product to the refineries of Hamburg and Belgium. At the outbreak of the war these firms are said to have had long-term contracts for the products of the Tonkin mines.

The immediate effect of the war was the breaking off of all business relations between French operators and German financiers, the withdrawal of German capital and the loss of a market for Tonkin zinc. The ore already in the hands of these foreign firms was tied up, and further production was precarious. Tonnage was lacking for the zinc available for exportation. In December, 1914, some of the leading zinc producers of Tonkin were seeking a market for their product on almost any terms.

Improved Conditions—Zinc for United States

But the situation soon began to clear up. German goods in French Indo-China were sequestrated in November, 1914. The decree forbidding the exportation of zinc was put into effect in Indo-China early in 1915. The belligerent nations had become convinced that the war was not a matter of a few months, and the consequent demand for metal was unprecedented. As a result the price of zinc began to mount, until on July 1, 1915, zinc ore at Haiphong was worth two or three times as much as on July 1, 1914.

With the rise in the price of zinc and with the demand for this product made by the allies and the neutral nations, the zinc mines began to resume operations. The smaller companies found themselves confronted by two serious handicaps; namely, the lack of sufficient financial backing and the mobilization of European operators and employees. As a consequence, although production in 1915 was greater than in any previous year, the product came entirely from a few of the larger firms. The product for 1916 will probably be 50% greater than that of 1915. Under more favorable conditions it could easily be four or five times as great.

During the early part of 1915 most of the exported zinc went to France; but the export restrictions were moderated, and later in the year a good share of this ore went to Japan and the United States. Between Oct. 1, 1915, and Feb. 1, 1916, the Société Miniére du Tonkin exported 9,325 tons of ore to Baltimore and 1,300 tons to Galveston via Marseilles—the first Tonkin zinc to be shipped direct to the United States. Most of the product of the Lang-hit mines is still finding a market at Baltimore, while it is understood that a Japanese firm has made contracts for the output of the mines of Tuyen-Quang.

Outlook for 1916—Future of Zinc Industry

Under the stimulus of unheard-of prices the larger zinc mines of Tonkin are now running at their utmost capacity, limited only by the difficulty and expense of installing new machinery and the practical impossibility of maintaining an efficient staff of European operators and overseers. In all the zinc fields a greatly increased production is foreseen, and the total product for 1916 is estimated at 50,000 tons. The value of such a product according to the present customs estimates will figure in the official reports of 1916 at about $1,185,000, but the market value at the present price will be at least $3,000,000.

The zinc-mining operations of Tonkin up to the present have been merely scratching the surface of the rich and extensive fields. The preliminary surveys of the country have marked on the maps the places where zinc is known to exist without much knowledge of the extent of the deposits.

The great needs of this industry are machinery, operating capital and transportation facilities. Under present conditions it is only profitable to exploit the richest ores near the surface of the easily accessible mines. Operating capital and improved methods of internal transportation would greatly enlarge the available fields, while modern machinery would enable the present mines to be worked at lower levels and would make it possible to extract the mineral from the lower grades of ore now thrown away. The question of establishing a central refining plant at Haiphong or some other place in Tonkin is now being agitated and has so many obvious advantages that it is sure to come.

The question of internal transportation belongs to the protectorate of Tonkin and the Union of French Indo-China, but the operating capital of the mines must be supplied from the outside. The mining regulations of Tonkin prescribe that a majority of the board of directors of any mining company must be French citizens or colonials. But there are two ways by which foreign capital can contribute to the development of this industry and participate in its consequent financial returns. Foreign zinc manufacturers can hold shares and form a minority of the board of directors with or without the consequent purchase of the product of the mines; or foreign capitalists can fill a long-felt want in Indo-China by establishing a loan and discount bank which will furnish the necessary capital to deserving enterprises.

Chinese Saltpeter

An American who has recently been employed with the engineering department of the Standard Oil Co. states, according to U. S. *Commerce Reports,* that he is in touch with certain Chinese who have secured a monopoly for the collection of saltpeter in three provinces. Interest appears to have been originally aroused in the subject by rumors of the probability of a large Russian demand; but this does not seem to amount to anytning at present, and the attention of the promoters has been turned to a possible American market.

The price originally quoted was $33 Mexican per picul of 133⅓ lb., and at the then rate of exchange the American representative calculated this meant the possibility of delivery f.o.b. treaty port (probably Tientsin) at a figure that would compete with the rate then ruling in New York. However, the gold value of silver has since appreciated somewhat—a factor which, of course, ordinarily militates against export trade—and further investigation would probably be necessary before such a price could be accepted.

The promoters claim to be able to deliver at three weeks' notice quantities of 400 to 500 tons. They have formed a company with a capital of $525,000 to $575,000 (gold) and say they are not looking for more, this being strictly a purchasing, not an investment, opportunity.

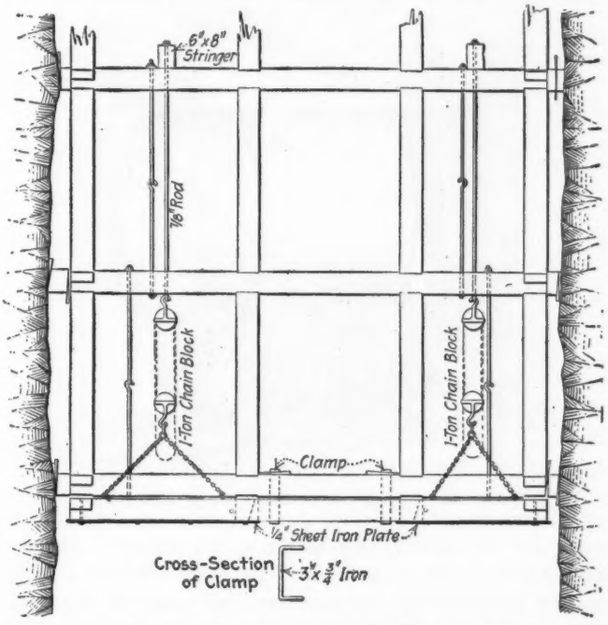
The Consolidated Interstate Callahan Mining Co., in its report for the third quarter of 1916, shows a net profit of $413,695. There was mined 38,695 tons of ore and 32,938 tons was milled, the average content being 25.7% zinc, 1.8 oz. silver per ton and 5.60% lead. The total mill recovery was 85.7%, and the recovery on the basis of metals paid for was 82.9%. The amount of zinc in the ore and concentrates shipped was 16,868,836 lb., and the lead in the two products was 1,454,562 lb. The cost of mining was $5.05 per ton extracted, and of milling, $1.252. Production is being maintained at the maximum. One dividend of $1.50 per share was made during the quarter, amounting to $697,485. A total of $4,649,900 has been paid since Apr. 1, 1915. The company has added materially to its property acreage during the quarter.

Details of Practical Mining

Rapid Shaft-Sinking with Suspended Bulkhead

By Walter Fitch, Jr.*

Extremely rapid progress in shaft-sinking has been accomplished at the property of the Chief Consolidated Mining companies' property at Homansville in the Tintic District, Utah. The suspended bulkhead and shooting set shown in the illustration permitted the timbering to be done without stopping the work in the bottom of the shaft. This was accomplished by lowering the bulkhead,



THE SUSPENDED BULKHEAD FOR USE IN SHAFT SINKING

by means of the chain blocks shown, a sufficient distance to allow for a set of timbers. This arrangement added greatly to the safety and speed of sinking. The shaft is 15 ft. 6 in. by 6 ft. 6 in. and is composed of two hoisting compartments 4 ft. 2 in. square each and a manway 4 ft. 2 in. by 3 ft. 2 in., all measurements inside timbers. The timbers used are 8x8-in. throughout, placed on 5-ft. centers in porphyry formations and on 6-ft. centers in the limestone formations. The shaft is lined throughout with 2x12-in. lagging.

The work of sinking was commenced on July 8, 1916, on contract by Walter Fitch, Jr., Inc., and in the first 31 days a total distance of 256.3 ft. of sinking had been accomplished. During the succeeding 31 days 261 ft. was sunk. The shaft was sunk through porphyry and limestone. The former was unfavorable for drilling on account of sticking and the plugging of the hollow steels used, but this disadvantage was balanced by its being favorable for mucking. The limestone was a hard close-grained rock, breaking into large pieces, which made mucking difficult. From three to four Denver Clipper drills were used with ⅞-in. hollow hexagon steel. A 5-ft. round of from 20 to 25 holes was drilled and shot every 12 hr. The air pressure was poor, ranging from 60 to 70 lb. Hoisting was done with two 15-cu.ft. buckets, used alternately and dumped automatically on top into a car by means of a fixed chain hooked into a ring in the bottom of the bucket which held the bottom stationary, allowing the top to tip over on an incline door and chute as the engineer slacked off on the rope. No crosshead was used in hoisting. The center compartment was lined with lagging and the bucket allowed to swing free.

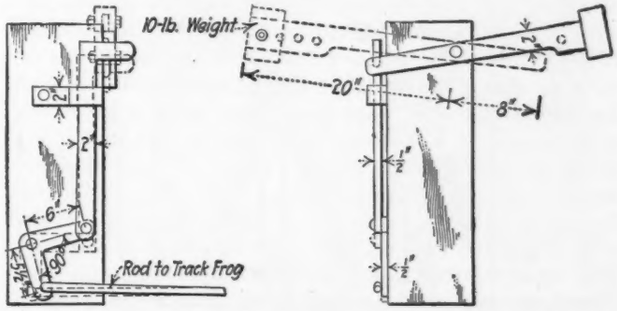
Three shifts of four machinemen each were used in the bottom. They drilled or mucked as the case might be. On day shift two timbermen did all the timbering. On top the force consisted of a topman and engineer on each shift. Every man on the job received $5 a day except the topmen, who were paid $3.25. The best speed was made in mucking, only men of exceptional mucking ability being hired.

*Contractor, Eureka, Utah.

A Mine-Track Switch

By Arthur C. Daman*

The mine-track switch shown in the accompanying sketch is recommended for its simplicity, both in construction and operation. It can be made in any mine blacksmith shop. It consists primarily of ½x2-in. strap iron and angles. It can be operated by the engineer without getting out of his car, by simply throwing the



A POSITIVE SWITCH THAT CAN BE OPERATED FROM THE CAB

lever weight to the opposite side. The switch holds fast and is kept snug against the track by the 10-lb. weight, thus making a perfect electrical connection. In going in a reverse direction to the switch, the frog will open, raising the weight and then letting it fall back into its original position as the wheel passes by. All haulage switches in the mines of the Calumet & Arizona Copper Mining Co. are of this type, the inventor being a trackman at the Junction mine.

*Mining engineer, 2678 Eudora St., Denver, Colo.

Efficiency with New Mine Cars

By Fred M. Heidelberg*

Four cars that have recently been put into general use by the Copper Queen company will be of special interest to engineers interested in the principles of efficiency, since the cars tend to better working conditions and eliminate waste.

Time study of a day's work revealed that an exceedingly large portion of time was consumed by the miner's running around and hunting things with which to work and which he should have had at his side. A tool car, shown in Fig. 1, was designed, therefore, to carry all the tools a miner might need in accomplishing a day's work. Upon arriving at his level the miner inspects his tool car and ascertains that all equipment, such as machine hose, both

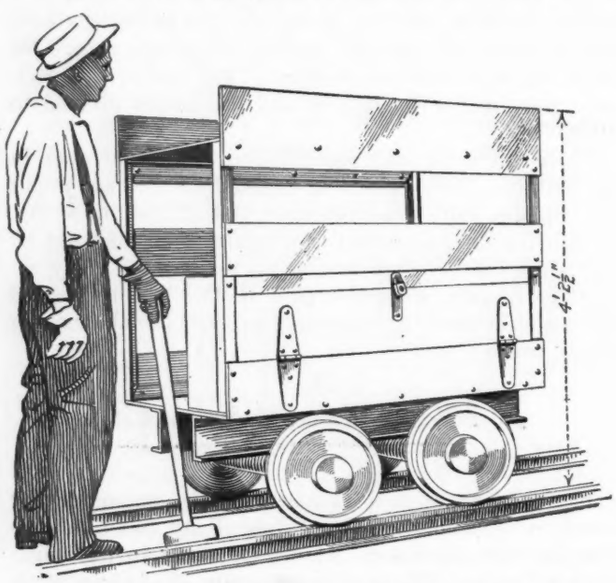


FIG. 1. FOUR-COMPARTMENT MINER'S TOOL CAR

water and air, tools, drill steel, gaskets, oil, etc., is in place. When he is sure that everything necessary to do his day's work is in its place in the car, he pushes it to his drift and begins work. The reader must admit that with this car fully equipped there will be little reason for the miner's leaving his place of work, thus eliminating a great deal of waste time. The design of the car is such that it will go on any cage in the mines. There are four compartments, counting the top platform. One of these is inclosed for carrying things easily lost or damaged and is provided with hinge and hasp so that it can be locked if necessary. The whole consturction is as light as possible, only 1¾x 1¾x$\frac{3}{16}$-in. angles, $\frac{3}{16}$-in. and ¼-in. plate being used.

The water car of 50 gal. capacity, illustrated by Fig. 2, was designed and built to obviate the inconvenience experienced when a water drill had to be worked in prospect drifts or where piping for water could not be conveniently put in. A great deal of piping that was formerly considered necessary could be avoided if these cars were on hand. The only work necessary to operate this car is to fill it with water at the hydrant, push it to the drift, connect air hose for pressure and water hose to the bottom of car and to the drill. Compare this simple operation to that of putting in a pipe line.

*Mechanical engineer, Copper Queen Mining Co., Bisbee, Ariz.

The over-all dimension of the tank is about 42 in. The cylinder is of $\frac{3}{16}$-in. steel plate, with heads of $\frac{3}{16}$-in. metal dished to a radius of 15 in. The water outlet is at the bottom and consists of a ¾-in. hose spud screwed into a ¾-in. throttle valve. There are two similar outlets on the top of the tank—one to serve as an air connection, the other for filling the tank with water. The tank rests in saddles forged from 6½x½-in. plates, to which 2½x⅜-in. straps encircling the tank are bolted. To these straps are riveted the bars that form the support for the platform on top of the tank. This platform can be of wood or steel plate as desired. The axles used were the standard timber truck axle, braced by means of 2½x⅜-in. bars. Some of these cars have tool boxes of No. 10 iron, fastened between the straps on the tank just under the platform. It is unnecessary, however, to have a tool box on this car if a tool car is part of the miner's equipment.

Fig. 3 shows the construction of the toilet car now in use in the mines. Anyone who has worked in a mine where this class of car is not used can realize what it

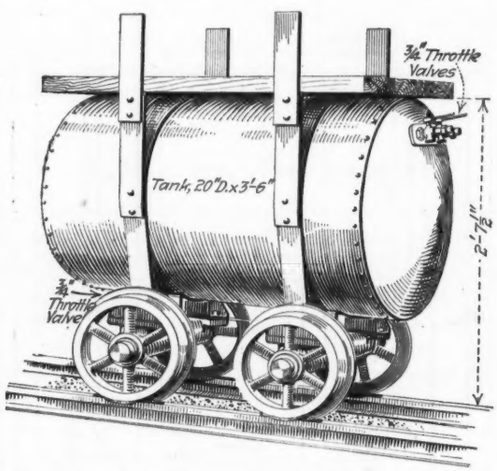


FIG. 2. DRILL-SUPPLY WATER TANK CAR

means in the way of sanitation and comfort. In the Copper Queen mines these cars have their stations and all men are compelled to go to these stations. At frequent intervals the cars are taken to the surface, emptied into the sewer, washed and disinfected.

The construction of the car is simple and somewhat resembles the old-time stage coach. The body is made of No. 10 plate riveted with $\frac{5}{16}$-in. rivets. Since No. 10 plate cannot be calked, a heavy tar paper was placed in the joints before riveting. The top plate is $\frac{3}{16}$ in. bolted to the body of the car so that it can be removed when inside repairs are necessary. There are two seats in this plate, provided with hinged covers, which can be latched when closed by turning the handle. A leather gasket is provided on the cover, and a rubber covering on the seat.

The car is emptied by means of a valve on a 1½-in. square stem. By turning the handle wheel on top of the car, the valve is raised or lowered by means of the threaded rod that works in the valve stem. A 2½x½-in. bar is provided inside of the car to keep the valve stem from turning. The valve seats on the cast-iron discharge, which also serves as a guide in the sewer. The reader can see the necessity of locking this valve. The method of locking is shown. While the original design called for the attachment of the pushing handles to the sides, so many men mashed their fingers in going through narrow

places with the car that it was considered advisable to attach the handles to the ends.

The storage-battery and blower cars are emergency cars for fire-fighting purposes and are illustrated by Fig. 4. It frequently happens that mine fires occur in inaccessible places where it is a difficult and slow process to get wires strung to them for operating a motor-driven blower. These two types of cars were designed and built so that the helmet crew could work without waiting for the installation of a motor and blower.

The batteries are always charged, and both cars are held in readiness at a central point. When a fire is discovered, the cars are rushed to the place; usually arriving ahead of the rescue crew. Thus the crew can begin constructing brattices if there is reason to believe that life is being sacrificed, or building bulkheads to confine the fire, while

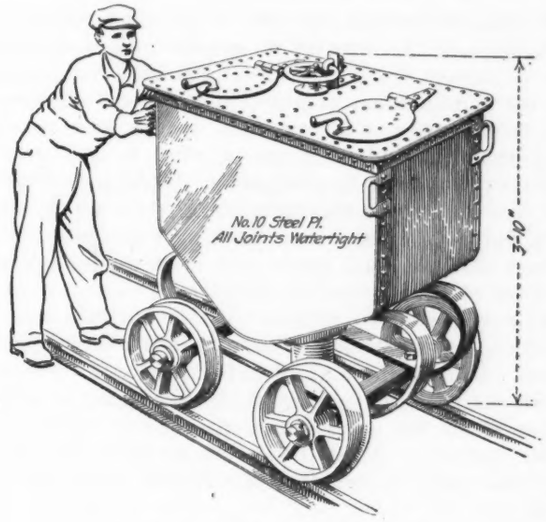


FIG. 3. MINE LATRINE CAR

the electrical department is doing its utmost to string wires and install a larger blower to displace this emergency blower. One can easily see that quite an appreciable amount of time can thus be saved and perhaps life too.

Two battery cars have been constructed at the Copper Queen—one as an extra if the other should run down and need recharging. The storage capacity of each is for about two hours' running, which was deemed ample time to allow for a more permanent form of blower to be installed.

The storage-battery car is nothing more than a tray mounted on standard axles. The bottom of the tray is of 4x6-in. timber on which is nailed the 2-in. plank floor. Small strips of rubber belting are nailed over this floor in order to allow any liquid that might be displaced from the batteries to run out through holes in the 2-in. planks. A containing cage of 2x2x¼-in. L's, securely braced, is provided with four 2-in. eye-bolts so that the entire car can be picked up and placed on a truck for transportation to the shaft where it is needed. A sheet of No. 10 iron is provided around the bottom of the tray to keep the batteries in place. The batteries are of the Edison type, and the group consists of seven trays of five cells each connected in series so as to give an effective voltage of 50 volts. The leads from the group connect to a socket to allow for a quick connection with the motor.

The blower car consists of a 4x4 frame and 2-in. plank body on which is mounted a No. 4 Sturtevant blower connected directly to a 5-hp. 110-volt d.c. motor, the windings of which have been changed so as to make it a

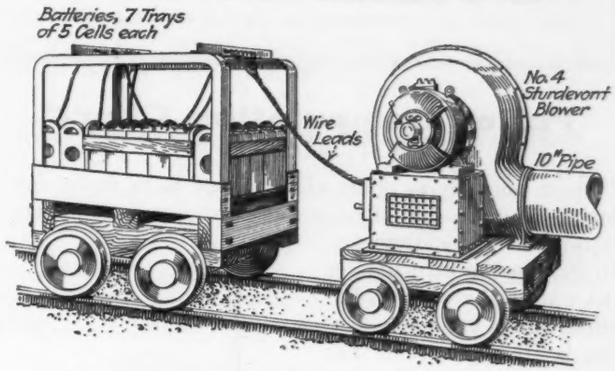


FIG. 4. STORAGE-BATTERY AND BLOWER CARS

50-volt motor. A small controller is attached for starting. When the blower car is in place, it is blocked up from the rails in order to steady it while running, and pipe is connected and led to the place where the men work.

Handy Flashlight Clamp

The accompanying illustration shows a clamp for a flashlight that was described in *Coal Age,* Nov. 11, 1916. This clamp was made so as to be able to take notes and also for use in setting up a transit in a mine where safety lamps are required. It is handy and

THE CLAMP AND ITS USE

useful and is recommended to mining engineers as well as to inspectors.

The flashlight can be hung on the cap or clothing. The clamp is made of tin ½ in. wide with a small bolt or screw for clamping, and a hook from an old oil pit lamp. This hook is soldered on underneath the clamp.

A 23-Stage Centrifugal Pump is being built for an Illinois mine by the Layne & Bowler Corporation, of Los Angeles, Calif. As the usual pump does not exceed five stages, the operation of this new pump will be followed with interest by those who have pumping problems at their mines.

Details of Milling and Smelting

Pulley Computation Chart*

By W. F. Schaphorst*

The accompanying chart will be found to be useful for determining the sizes of pulleys required for given power-transmission requirements. It removes the necessity for the use of the various formulas and is extremely flexible in its application. For example, a motor running 1,200 r.p.m. is to drive a lineshaft at 300 r.p.m. What sizes of pulleys should be used? On the slip of paper in position *A* make marks opposite the 300 and the 1,200, as shown. Then slide the slip of paper up to wherever you want it. Position *B* shows that pulleys 15 in. and 60 in. diameter respectively will do the work very well. Of course, if those diameters are considered too large, the slip can be moved a little higher and the best diameters can be chosen. No matter where the slip is placed, the ratio is always correct. The chart also lends itself readily to the solution of such a problem as—Knowing the pulley diameters and the speed of one of the pulleys, what is the speed of the other pulley? For example, pulley diameters of 8 and 50 in. are used. The speed of the 8-in. pulley is 200 r.p.m. What is the speed of the other pulley? The answer is 32 r.p.m. Try it by means of the chart. As speed of rotation and diameters bear an inverse ratio to each other it will be necessary to invert the figures when obtained or else reverse the slip of paper between position *A* and *B* in the figure.

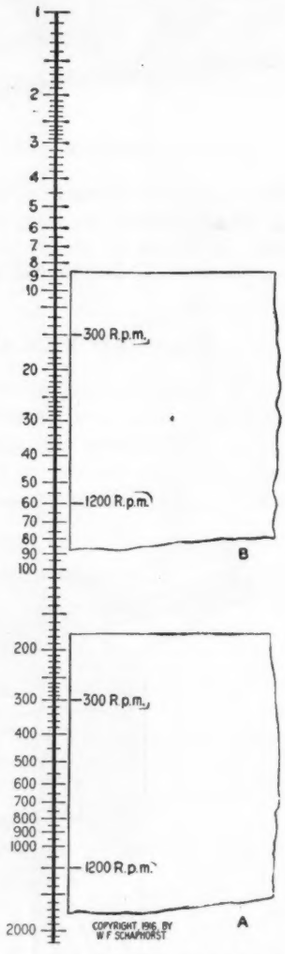


CHART TO CALCULATE PULLEY RATIOS

Injury Through Heat and Fumes

The Texas Court of Civil Appeals has affirmed judgment in favor of an employee of a smelting company, who sustained personal injuries through existence of heat and gases in a furnace in which he was required to work before the furnace had been permitted to thoroughly cool off. He asserted liability on the theory that the company was negligent in failing to warn him of the dangers which resulted in his injury and of which he was ignorant, and the court finds that there was ample evidence to warrant the jury in its conclusion that there was such negligence. (Dill vs. Consolidated Kansas City Smelting and Refining Co., 188 Southwestern Reporter, 439.)

Mine Rock in Tube Mills

By Charles Labbe*

In order to reduce the cost of grinding where tube mills are used, in some of them mine-rock is employed with advantage instead of pebbles, domestic or imported, but the consideration is purely a local one. Imported flint pebbles are now a very costly item in mills situated away from railroads, but are superior to any granite or porphyry of domestic production. These wear flat and give poor service, the transportation charges are the same as on flint pebbles, and from practical experience it may be said that they are economical only where they can be obtained from a hauling distance.

Mine-rock used in place of pebbles never comes in round shapes as pebbles do, but always in sharp, angular shapes. This is the main drawback, because there is a loss in efficiency in grinding off the edges; but in several places where the ore is hard, they have replaced the pebbles entirely. A few little changes have been necessary, the most important being in the preparing and handling.

In milling, tonnage is now the main consideration and ore sorting in the mine is rarely done. The sorting, if any, is done at the crushing plant, and this is usually where the pieces of ore are sorted for tube-mill use. They must be the hardest pieces and as uniform as possible—the ones approaching the round shape are to be preferred. They are either piled to one side or thrown directly into an ore car or a special bin. From the crusher room the rock is carried to the tube mill either in wheelbarrows, ore cars or through a chute. The handling being the largest expense, every possible opportunity must be taken to lessen it; by gravity fall this cost is reduced to a few cents per ton.

One of the largest mills using mine-rock as a tube-mill grinding medium is the Aurora, having a daily tonnage of over 500, with 40 stamps crushing to 4-mesh and six 6x16-ft. tube mills. The ore is elevated from the crusher to the bins by a belt conveyor, one man tending to this belt, keeping the ore bins full and picking the largest pieces of quartz (about 3-in. cube) and dropping them into a chute. On the battery floor is a car and track going from this ore-bin gate by a trestle over every tube-mill manhole and every shift (three times per day) each tube mill is stopped with the manhole at the top, the door is opened and about a ton of mine-rock is dumped in. A square sheet-iron hopper fitting the manhole facilitates the operation—less than five minutes is required for each tube mill.

*Copyright, 1916, by W. F. Schaphorst, Woolworth Building, New York.

*Mechanical engineer, Johnnie, Nev.

In a mill in southern Nevada the man tending the crusher sorts the mine-rock and the hardest pieces (about 4- to 5-in. cube) are thrown into a 6-in. iron pipe having a 5-in. opening to make sure no piece will clog the pipe, the rock falling into a box within reaching distance of the tube mill. The rock is fed by hand into the scoop at regular intervals; a man standing on the platform, with one hand takes rock from the box and throws it in the scoop at nearly every revolution. The scoop is of large size and never clogs. In another mill the rock is brought near the tube mill in an ore car direct from the crusher room and is hand-fed to the scoop. There are mills where the rock is brought near the tube mill in wheelbarrows or carried in hand boxes or in ore sacks, but hand labor is expensive and costs must be figured close to compete with pebbles.

Tube mills with lifter bars handle mine-rock better than mills with continuous smooth lining, for the reason that a rock with a flat face may keep sliding on one side and not get a chance to roll and round itself up like a pebble. With the lifter bars a rock of any shape is sure to be thrown away from the lining after a travel of only a few feet.

The tubes of the first-mentioned mill have lifter bars and Komata lining and use mine-rock exclusively. At a speed of 20 r.p.m., each grinds about 85 tons per 24 hr. The lining lasts about 2 years, where in a 5x22 ft. mill running 28 r.p.m. silex lining lasts about 10 to 12 months, grinding 50 to 60 tons per day. The feed is $\frac{3}{16}$ in. from rolls, both mills making a 200-mesh product.

The cost per ton of flint pebbles is about $50 to $60 for mills in Nevada. Porphyry pebbles cost about $40. To make the change to mine rock depends on local conditions. Where a man stands by a belt and has only to push the rock off, he can sort from 15 to 20 tons per 8 hr., but if the rock has to be lifted and carried away a few feet, a few tons is all that can be figured upon and costs will rise materially.

The change is not necessarily a radical one. Many mills are reducing the feed of pebbles and replacing it with mine-rock without cutting down the grinding efficiency. Before using mine-rock exclusively in tubes at the Aurora mill, imported flint pebbles were used, several tons per day costing delivered at the mill $50 per ton, thus making just that many tons of barren rock to handle in the cyanide plant. The grinding efficiency has not suffered, because the daily tonnage has increased; the extraction has not suffered, because the rock remains longer in cyanide solution.

Preparation of Tungsten Metal

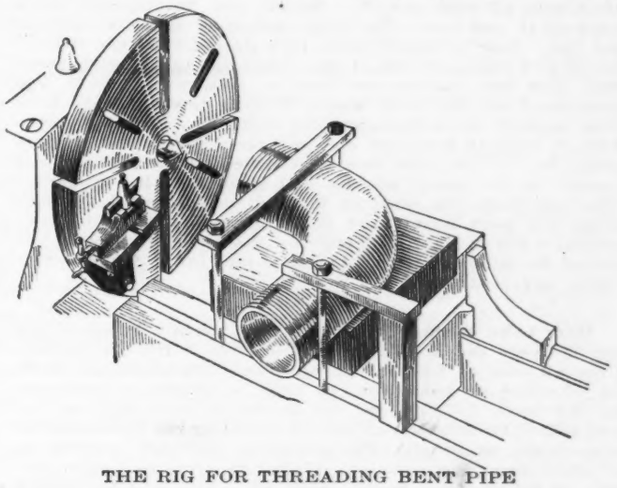
In a recent treatise on rare metals Dr. Herman Fleck[1] describes the preparation of tungstic metals from ores. Concentrates are ground very fine in tube-mills and are fused on a reverberatory hearth with sodium carbonate (soda ash) and a little sodium nitrate. This disintegrates the material and the mass is then drawn, crushed and leached with hot water. Sodium tungstate is dissolved and the iron and silica remain with the insoluble. Undissolved sodium meta-tungstate is converted to normal tungstate by treating with a solution of caustic soda. The concentrated solution of sodium tungstate is heated and poured into hydrochloric acid. Tungstic acid (WO_3) is precipitated as a yellow powder. This is filtered, washed in acid-proof presses and dried.

The tungstic acid (oxide) is mixed with some pure form of carbon such as charcoal or petroleum coke and the charge is pressed into graphite crucibles and heated in coke furnaces to a high temperature. A coarse, steel-gray dense tungsten is obtained that, with care, may be kept below 1% carbon content.

[1]Proc. Colorado Scientific Society, Denver, Colo., October, 1916.

Threading Ends of Bent Pipe

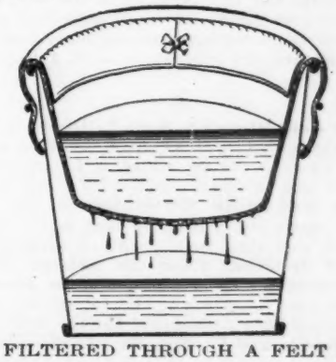
The problem of utilizing short pieces of bent pipe is an ever present one about metallurgical plants of all kinds. Such a policy of utilization keeps down the size of the junk pile and helps toward increasing profits, besides being a great comfort in times of urgent need. Therefore the method described by H. J. Smith, in *American Machinist,* Nov. 2, 1916, and shown in the accompanying illustration, is worth while putting on record. By putting an angle plate with a small compound rest on the faceplate, the operator was enabled to use a lathe for the purpose. The pipe was fastened in blocks on the carriage, as shown in the illustration. By running the lathe backward it was possible to cut off, turn and chase the thread.



THE RIG FOR THREADING BENT PIPE

Oil Filter for a Small Plant

A tin can and a felt hat combined, as shown in the illustration, says Jan Spaander in *Power,* make a first-rate and inexpensive filter for oil, in a plant that does not justify the purchase of an expensive apparatus. If there are holes in the top of hat, pieces of felt (taken from the brim) can be stitched over them.



OIL FILTERED THROUGH A FELT HAT

Company Reports

Jumbo Extension Mining Co., Goldfield, Nev., in its operations for the year ended June 30, 1916, produced 35,541 dry tons of ore, averaging $31.64 per ton in gold, or a total of $1,124,487. Smelter losses were $153,703, or $4.32 per ton, leaving smelter recovery of $27.32 per ton. Last year's ore averaged $61.58, with smelter losses of $4.71 per ton. In addition to the ore mined, dump ore to the amount of 882 tons was sold, netting $1 per ton. The expenses of "smelter losses" include arbitrary deductions made by smelters, in addition to reduction charges of 5% on gold and silver and one unit of copper. The expenses of the year, including mining, transportation, taxes, construction, administration, general expenses, etc., were $562,426, or $15.82 per ton. Development work to the amount of 8,917 ft. was accomplished this year, at a cost of $6.95 per ft. Mining and development costs were $5.40 per ton. The total operating costs were $5.57 per ton. Four dividends were paid during the year—one of 5c., two of 7½c., and one of 10c.—the total aggregating $465,000. The cash balance on June 30, 1915, was $120,533, and that on June 30, 1916, was $103,274. Developments have been carried on uninterruptedly from No. 1 shaft on the 1,000-ft. level to the south and in three different directions in shaft No. 2. No new ore of commercial value has been opened up for many months, and production has come exclusively from ore reserves blocked out during 1915. The drain has been heavy, and it is apparent that, while considerable ore in sight still remains, the end of the productive life of the mine is not remote unless new ore is found in territory under exploration.

⁂

Kerr Lake Mining Co., Cobalt, Ont., during its operations for the year ended Aug. 31, 1916, showed a total production from all ores of 2,433,793 oz. of silver. This includes 61,761 oz. of silver on hand Aug. 31, 1916, according to inventory. Of the total, 1,438,600 oz. was produced from shipping ore and 595,192 oz. from low-grade ore milled by the Dominion Reduction Co., at Cobalt. The production included 1,171,799 oz. of silver from first-class ore, 175,787 oz. from first-class bullion, 83,467 oz. from second-class ore, 7,547 oz. from bullion and metallics and 995,193 oz. from mill ore.

Including drifting, crosscutting, sinking and raising, 4,057 lin.ft. of development was accomplished during the year. This is slightly less than that done during the previous year, the decrease being accounted for by the fact that more was done in the slower work of sinking and raising. Although exploratory work was distributed well over the property and a considerable amount was done at greater depth than before, discoveries of importance were few. Some additions were made to known reserves through development of extensions and side stringers. The mining cost amounted to $3.68 per ton for 58,850 tons of ore hoisted, or 8.89c. per oz. for 2,433,793 oz. of silver recovered. In spite of a gross production of 2,433,793 oz., the ore in reserve shows little diminution over that reported last year. This is partly because of extensions to the veins by development, but mostly because of the fact that production of both mill-run and high-grade was much better from nearly all the veins than estimates made from former production of blocks of equal area had indicated. As a result some of the former estimates have been revised upward. The estimated ore reserve on Sept. 1 includes 3,827,000 oz. of silver.

⁂

The Tomboy Gold Mines Co., Ltd., Telluride, Colo., in its report for the year ended June 30, 1916, shows a profit realized of £76,923, to which is to be added a balance brought forward from the last account of £20,778, making a total of £97,701. There was milled 150,488 tons of ore, from which bullion to the value of $1,074,088 has been realized, at a cost of $720,866, resulting in a profit of $353,222. If to this profit be added dividends from the Tomboy Tramway and Tunnel Co. and receipts from other sources, $29,566, the total surplus for the year's working will be shown to amount to $382,788. The average working cost for the year, including all expenses in America and London, was $4.92 per ton. The ore reserve amounts to 575,000 tons, the amount comprising 175,000 tons in the Argentine group of mines and 400,000 tons in the Montana property. The mill has established a record for the tonnage of ore treated and has run satisfactorily through the year. The cyanide plant has yielded a profit of $21,702 for the twelve months. The cyanide plant treated 132,200 tons of tailings, recovering therefrom bullion valued at $160,476 at a cost of $0.90 per ton and yielding a profit of $0.31½ per ton of tailings treated. The total income from all sources, including the ore at the mill, the concentrates produced, cyanide bullion, dividends from the Tomboy Tramway and Tunnel Co., boarding house, rent, etc., amounted to $1,103,654. Total expenses were $720,866, leaving a profit of $382,788. The cost per ton for mining and developing was $2.42; for milling expenses, $0.52; for concentrating expenses, including transportation to railway, $0.49; for water-supply expenses, $0.09; assay-office expenses, $0.02; cyanide expenses, $0.79; general expenses, $0.2; and taxes and insurance, $0.26; making a total of $4.79 per ton.

⁂

Chief Consolidated Mining Co., Eureka, Utah, in its report for the year ended Sept. 30, 1916, shows a total amount of work done of 17,950 ft. The total shipments of ore were 62,006 tons, yielding, after the payment of smelting, transportation and sampling charges, $1,153,000. The metal content of this ore per ton was 0.104 oz. of gold, 21.7 oz. of silver, 13.08% lead in lead ore, 1.95% copper in copper ore, and 30.5% zinc in zinc ore. The average gross value per ton was $31.38, the cost of smelting, freight, sampling, etc., $12.78, leaving an average net value of $18.60 per ton. The net profit after the payment of all charges was $474,247. Three dividends were paid—one on Feb. 7, dividend No. 7, amounting to $44,033.80; No. 8, on May 1, $44,148.15; and dividend No. 9, on Aug. 2 amounting to $44,149.55. The balance of cash on hand Oct. 1, 1916, was $446,970.

⁂

The Round Mountain Mining Co., Round Mountain, Nev., in its report for the year ended July 1, 1916, notes that the construction work on the Jett Creek pipe line had reached a stage permitting water to be turned into the line on June 24, 1915. The main tailings flume, 2,700 ft. long, was completed to a point requiring the use of a giant to cut a branch race into the block of ground selected for hydraulic mining during the remainder of the season. Active hydraulic mining began on July 13 and continued to Sept. 3, when the flow of water in Jett Creek had decreased to such an extent as to make it advisable to utilize it in cleaning up the bedrock that had been exposed. Gravel to the extent of 18,159 yd. was hydraulicked, yielding $36,414. Of this amount $26,997 was recovered from the boxes and $9,417 from bedrock. The total cost was $11,058, leaving a net realization of $25,356. The value per yard recovered was $2.006 and the total cost per yard $0.609, divided as follows: Hydraulicking, $0.395; bedrock cleaning, $0.214 per yd. The net realization was $1.397 per yd., representing a profit on operations of 69.6%. In November hydraulic operations were resumed with one shift. During December and January 30 days were lost. Up to Mar. 1, 1916, 5,272 yd. was handled, the value recovered being $9,204 and the total cost $5,397, leaving a net realization of $3,806. The value per yard recovered was $1.746, the cost $1.023, leaving a net realization of $0.723 per yd., representing 41.3%, of the value recovered. From Mar. 1 to July 1, 1916, 142,600 yd. of gravel was hydraulicked, yielding $48,177. Of this amount approximately $4,760 was recovered from bedrock. The total cost was $27,898, leaving a net realization of $20,279, or 42% of the total amount recovered. The value per yard recovered was $0.338, the cost $0.195, and the realization $0.143. Up to July 1, $0.338 per yd. has been recovered from the sluices and from bedrock cleaning. In addition there is estimated to be from 5,000,000 to 10,000,000 in the branch races of main tailings flume, this amount being not recoverable while active mining operations are going on. It will be cleaned up at the end of the season. Results do not call for any change in original estimate, as the latter are representative of large blocks of ground and not merely local sections. Before 1915 an average of $1.55 was recovered from all gravel washed on various sections of the property. Therefore an estimated average of $1 per yd. recovery is conservative. The results obtained this year could not be foreseen, as it is evident that a large low-grade area was encountered adjacent to ground yielding over $2 per yd. Operations in 1917 will be conducted with a view to obtaining the maximum efficiency from the water, and it is believed that hydraulicking costs will be reduced to $0.15 per yd. or less.

Correspondence and Discussion

A Cadmium Myth?

In the *Engineering and Mining Journal* of Sept. 23 there is an editorial entitled "A Cadmium Myth?" The interrogation point is necessary. There is no myth about the deleterious effect of cadmium in many cases, as the editorial frankly admits in the last paragraph.

Slush castings cannot be made successfully from cadmium-bearing spelter. A very little cadmium will spoil the spelter for this purpose, as it is impossible to obtain any uncracked castings from metal containing 0.05% or more cadmium.

In galvanizing telegraph and telephone wire, which has to stand the severe bending of the lineman's splice, it is essential that the spelter employed shall be free from cadmium, as the latter in minute proportion renders it much harder and more brittle, causing the coating to crack and peel. The hardness of spelter as shown by its resistance to compression is an accurate measure of its brittleness. The following table shows strikingly the effect of cadmium in small quantities on the hardness of spelter:

EFFECT OF CADMIUM ON HARDNESS OF SPELTER

% Cd	Load for 10% Compression, Lb. per Sq.In.	Relative
0.00	16,246	100
0.02	18,660	115
0.05	20,080	124
0.08	20,950	129
0.20	26,870	165
0.25	28,270	174
0.27	28,700	177

Cadmium dissolves in zinc up to about 1%, and all these solutions are hard and brittle. Cadmium-bearing spelter rapidly shows a brownish tarnish, and the extent of this increases with the increase of cadmium.

There is no question but that cadmium is injurious in manganese bronze. Most of the makers use the same brand of spelter for the better qualities, and it is one that is free from cadmium. Nearly all have tried other spelters containing about the same amounts of lead and iron, and in addition cadmium, but have abandoned them on account of the injurious effect on the product. I have no reliable figures on the proportion of cadmium necessary to produce these bad effects, but from my knowledge of the composition of the spelters that have proved unsatisfactory, I know it to be of the same order of figures as those found to be injurious in slush castings and telegraph and telephone-wire galvanizing.

It is frequently stated that cadmium in spelter makes no difference in the manufacture of brass, as it is all driven off in smelting. As evidence in support of this, the boiling points of cadmium and zinc are quoted. The former is 766° C. and the latter 906° C., from which it is argued that as the casting temperature of brass is much higher than the boiling point of either, the cadmium must be driven off. The boiling point of copper is 2,310°. The casting temperature of brass is from 950° to 1,100° C. An average sample of flue dust from a large brass plant contained: Zn, 26.94%; Cd, 1.01; Cu, 2.36. In other words, there was twice as much copper driven off as cadmium, although the temperature of the metal was 1,200° to 1,400° below the boiling point of copper and 200° to 300° above that of cadmium. Assuming that a 40-60 brass is to be made from pure copper and a "brass special" spelter containing 0.4% Cd, the loss in melting will be about 3%. On the basis of the flue-dust analysis already given, this would consist of: Zn, 2.7%; Cd, 0.1; Cu, 0.2. The results then are as shown in the following table:

A 40-60 BRASS MADE WITH "BRASS SPECIAL" SPELTER

	Zinc	Copper	Cadmium
Materials charged	42.7	60.2	0.17
Loss in melting	2.7	0.2	0.10
Resulting brass	40.0	60.0	0.07

The brass would contain enough cadmium to cause severe cracking if it were a slush casting or galvanized coating. Deductions from boiling points, therefore, would appear to be of little value.

The separation of cadmium from zinc and copper is difficult, and neither the textbooks nor many of the schools give directions on this point that are of any value. I have frequently known chemists of experience to report spelter as entirely free from cadmium when it actually contained a relatively large amount. In other cases they have reported from a half to a quarter of that really present. As it is even more difficult to determine cadmium in brass than in spelter, I have great doubt whether most of the statements regarding the absence of cadmium in brass are of any value.

The following analyses show that cadmium is found in brass in quantities comparable with those that cause trouble in slush castings and galvanized material: Rolled manganese bronze, 0.015% Cd; rolled or extruded manganese-bronze bar, 0.040; manganese-bronze bolt, 0.035; manganese-bronze bolt, 0.035; manganese-bronze casting, 0.060; manganese-bronze casting, 0.090; manganese-bronze casting, 0.030; drawn-brass bolt, 0.040; drawn-brass bolt, 0.030; brass ingot, 0.035; brass ingot, 0.054; brass ingot, 0.034; brass screen rim, 0.040. Fig. 1 is an illustration of the first specimen analyzed and shows severe cracking. Fig. 2 is the second and shows a curious system of reticulated cracks. Fig. 3 is the last specimen. It is the frame of a testing screen that had been kept for some months in a dry storeroom wrapped as shipped by the makers. When taken out, it was in the condition shown and had a slight irridescent tarnish, but no other sign of corrosion.

Large quantities of cadmium are admittedly injurious to brass, and the reason for this is quite obvious. The alloys of zinc and cadmium are, as already stated, very brittle, and an examination of brass containing from 1 to 3% of cadmium plainly shows a concentration of an alloy rich in zinc and cadmium along the boundaries of the brass crystals. With lower cadmium this alloy layer is difficult or impossible to see, but it may exist and be an element of weakness.

Season-cracking is due to overstrain from cold working. Therefore, if the strain is sufficient, cracking will occur regardless of the composition. The cracking rarely shows unless there has been some corrosion, a slight amount being

sufficient to start the trouble. Impurities may increase the liability of cracking in any one of three ways: (1) They may so affect the brass that it is more easily strained by cold working; (2) they may increase the liability of corrosion, especially if they tend to segregate; (3) they may segregate to such an extent as to create lines of weakness in the finished material and cause it to give way locally under strains that would not affect the body of the alloy.

Cadmium does admittedly make brass more sensitive to heat treatment and is therefore likely to make it more susceptible to overstrain.

A fraction of 1% of cadmium in aluminum-zinc alloys causes disintegration from corrosion under conditions that leave a pure alloy unaffected. It is probable that it has a similar effect in copper-zinc alloys.

Cadmium in brass in large quantities segregates as a brittle alloy at the boundary of the crystals.

All these effects show that cadmium causes weakness and increases the liability of cracking. It is significant that the brasses that are most likely to contain cadmium are those that give the most trouble from season-cracking. It is a well-known fact that brass of about 40 zinc and 60 copper is more likely to season-crack than any other. As the cadmium, if present, is always introduced by the zinc, the high zinc content of this alloy gives a greater chance of high cadmium. It is usually made from the grades of spelter most likely to contain cadmium.[1] Its melting point is the lowest of any of the common brasses, and therefore a smaller proportion of the cadmium is likely to be eliminated in the making.

I have shown that brass not infrequently contains an amount of cadmium that would cause serious cracking in spelter used for slush castings or galvanizing. As cadmium tends to cause brittleness and to increase the liability of corrosion in alloys, it appears reasonable to suspect that it is often a contributing agent in the failures of brass and similar alloys. GEORGE C. STONE.

New York, Oct. 9, 1916.

[1]Twelve samples of "brass special" spelter made by five different makers average 0.22% Cd; ranging from 0.005 to 0.430%.

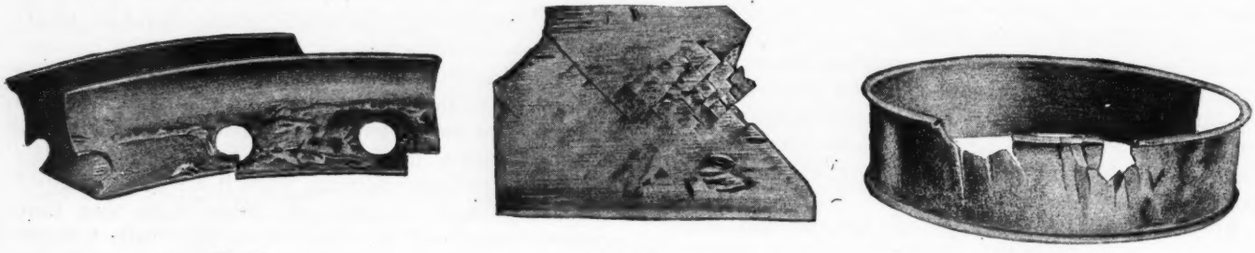


Fig. 1 Fig. 2 Fig. 3

SPECIMENS SHOWING THE EFFECT UPON BRASS OF CADMIUM IN THE SPELTER

The Attempted Tyranny of Labor Unions

Although I have never before burst into print in the discussion of public questions, the letter of William Cullicover on "The Attempted Tyranny of Labor Unions" has prompted this reply. There are several thousand William Cullicovers throughout the country, and I believe this letter may help a little to set them thinking.

Mr. Cullicover wants to know how many feel as he does. The word "feel" is aptly used. If he had thought about his subject instead of feeling, he never would have written his article. It is a very common thing for men to appeal to the passions of their fellowmen (especially to the less intelligent) rather than to their brains. Mr. Cullicover shows that his article was written in passion by using insulting language because the editor held different opinions from his own. Consequently he appeals to the passions of his readers. Now passion has caused many a man to commit rash and senseless acts, but it never has convinced anyone.

In regard to the subject of his article, the threatened—and threatening—railroad strike, Mr. Cullicover tells a truth when he says there are only two parties involved. There are only two—the strikers and the public. The man who sits in an office and handles the financial end of railroading and the man who sits in the cab and handles the throttle are co-workers. One cannot get along without the other. Each has his job. In the United States there is only one class—the laboring class. When one set of workmen strike for higher pay, the other workmen have to pay it. For they are the consumers, or the public if you please. In the recent threatened strike the railroad managers were the public's only champions.

There are times when strikes are justified. When one set of workmen are treated unjustly by the other sets of workmen that comprise the public, they have a right to protest.

The man who uses his muscles for making a living usually voices his protests through his muscles. He throws a brick at the man who uses his brain for making a living. The one feels and the other thinks, and it is called a war between capital and labor. The man with the brain often deserves the brick, but he generally realizes more keenly than the man with the brick that it is poor policy to treat his fellow workman with injustice.

Let us quit talking about war between capital and labor. It does not exist, because labor is capital in the creation. Let us fellow workmen stop throwing bricks. Let us feel less and think more. In regard to what Mr. Cullicover calls class control, it is only natural that those best fitted for leadership should assume that position. It is the reward of brains and industry. It is as inevitable as the law of supply and demand. It is only when those at the top begin to erect unnatural barriers between themselves and their fellow workmen that classes are created. This is un-American, just as much as the blind hatred that some men hold for the capitalist.

Before we make the charge that class control exists in America, let us be sure that it does exist. I believe that there never was a country in which there is less of the so-called "class control" than in the good old U. S. A.

El Paso, Tex., Nov. 1, 1916. L. M. SHERIDAN.

Plant Fire Protection

By Frank M. Leland*

SYNOPSIS—The importance of plant fire protection is usually underestimated. It is necessary not only to have the equipment, but to have it in order for immediate use. This condition is attained only by frequent inspection and unexpected test drills. Carefulness and a respect for fire are to be drilled into the men. This latter is perhaps the best safeguard.

A large number of men operating mines, mills and smelteries have, no doubt, different methods of fire protection, most of which consist of hydrants with hose reels and hose distributed at various points about the plants. Some of these are operated by pressure pumps, but the majority are supplied by gravity pressure. Irrespective of the source of supply, the keynote to the whole system in case of fire is the condition of the hydrants, hose and fittings. Some years ago on taking charge of a plant, I made an inspection and noted that the fire hydrants did not look as though much attention had been paid to them, so I questioned the master mechanic, whose business it was to see that they were in condition for immediate use, and he said he was responsible for them. I asked him if they were all right in case of fire. He replied that they were, so I said that we would have a fire right away and pointed to the scalehouse and said to him, "Imagine that is on fire and see how soon you can have a stream on it." I noted the time he started for the hydrant nearest the scalehouse and I waited for the stream. After about two minutes I saw him start for the machine shop and pretty soon come back with a 6-in. monkey wrench and a helper carrying a length of hose. They started to screw on the hose, but it went on hard and the spanner was gone, so he sent the man for a spanner and the man went to three other hydrants before finding one. The gate valve was stuck, and he used the monkey wrench to open it up. When they finally got the stream on the scalehouse, it was a trifle over 16 min. from the time he started. He said it would not have happened only a day or two before; the men had taken that hose to wash out the locomotive boiler and had forgotten to put it back, and that particular hydrant had not been opened for a long time and the valve was stuck, and all the usual excuses for not having it in shape. There were 14 other hydrants, and we went over them all and only three of them were in shape to give immediate results. I then put some signboards on top, painted a number on each hydrant house and told him to make a report each week and put down each number on his report and be sure they were right. This he did, but I did a little inspection on my own account and generally found something deficient, so I had some blanks made out to be filled in. Even that was not satisfactory, so I finally had him put the matter up to the night watchman and we had some blanks printed containing the following headings: Number of hydrant, location, size, condition of hose and valve, nozzle in place, spanner in place and general remarks. Two copies were made out—the original to be left at the office and the carbon copy given to the master mechanic. After that I would drop around at any time and call for a stream from some hydrant selected at random, and from that time on we never had any more trouble. Since then, at any property in which I am interested, one of the first things done is to get the fire protection in shape, and it is kept so by continual inspection.

*President, Balaklala Consolidated Copper Co., Coram, Calif.

The Use of Stationary Fire Towers

Where there is a pressure of a 250-ft. head or over, I have found it best to dispense with hose and all the troubles that go with it, and build several platforms from 10 to 15 ft. high, with ladders attached, and on top place a small hydraulic giant made on the same plan as those used for hydraulic mining. They are double-jointed and swing up and down and also can be swung in a complete circle. Make them with a 1⅛-in. nozzle and be sure your mains are large enough to give them a good pressure; then try them out two or three times each week. This can be done with this form of hydrant better than with a hose, as there is no hose to dry out and roll up after the test, there are no spanners to lose and no one will steal the nozzle and sell it for junk. Anyone can make these if a machine shop is available, but there is a firm in San Francisco that makes them for this express purpose.

No matter what form of fire protection is used, it cannot be depended upon unless someone is made responsible, and whoever it is must try all the devices at some stated period so as to be positive that everything is in working order. I will venture the assertion that many managers who have fire-protection plants will find many a loose screw unless they have some form of inspection and tryout, and a few might find themselves in the position of my friend Jim, who was running a 20-stamp mill and a big hoisting plant in Oregon several years ago. He was showing me over the plant and pointed out where he had put pipes all about and had nice swinging hose reels where all you had to do was to take hold of the nozzle and pull the hose out and signal to the engineer to start the fire pump. I said "Fine! Pull one out and signal." He did, and the engineer turned on the steam. Nothing happened, and after waiting a few minutes, we went down to the engine room and found the engineer hammering the side of the cylinder and steam chest but to no avail; so he took off the head and found that, owing to a leaky throttle, the water had gradually rusted the cylinder and the piston which moved the valve so that they finally had to be soaked with kerosene for 24 hr. and then started with a jack. After that lesson the fire pump was tested out every day. A fire drill is a good thing, but the best protection I know of is for the boss to go around at some unexpected time, the call for a stream of water.

The Value of Carefulness

Carefulness is also an important factor, and generally speaking, when you see a man light his pipe and throw the match on the floor, even if it is a dirt floor, he should be cautioned, and should he do it again he should be discharged. In fact, any man who is the least bit careless with fire should be got rid of at once. How many times

do we see a man take a nut for a candlestick and set it down on a greasy bench or on a dry pine window sill and perhaps go off and leave it? The building burns and no one knows how it happened!

A lot of fires are started by men burning rubbish outdoors. I make it a fixed rule that no fires are to be started outdoors and that all rubbish must be hauled to the boiler; if the plant has no boiler, it must be hauled away. Water buckets placed at intervals around a building and kept full of water, which in a cold country should be made strong with salt to prevent freezing, are a good thing.

Most of the patent fire extinguishers are good if kept in condition, but generally speaking, the best insurance is careful men from the boss down to the roustabouts, and any man who shows that he is careless with fire is a good man to get rid of.

Zinc Producers' Association Proprietary, Ltd.

Some further particulars are now available regarding the organization of the Australian zinc producers to eliminate alien-enemy control and to provide an outlet for Australian zinc products. It will be recalled that the Zinc Producers' Association Proprietary, Ltd., was organized at Victoria, South Australia, on May 20, 1916, with a nominal capital of £100,000 in £1 shares.

After enumerating the various steps taken to eliminate alien-enemy control, the London *Financial Times* states that the number of directors is not to be more than 15; that each of the following companies may nominate one director: Broken Hill Associated Smelters Proprietary, Amalgamated Zinc (De Bavay's), Broken Hill South Silver Mining Co., Broken Hill Proprietary, Block 10 Co., Broken Hill Proprietary Block 14 Co., Junction North Broken Hill Mine, Broken Hill Proprietary Co., Mount Lyell Mining and Railway Co., Sulphide Corporation, British Broken Hill Proprietary Co., Zinc Corporation. The Burma Corporation, Ltd., is also mentioned as having power to nominate a director if it become a member of the company.

There is to be a London board, an advisory member of which may be appointed by the Imperial Government. The directors on Oct. 18 were: W. L. Baillieu, W. M. Hyndman, M. Cohen, G. A. Grant, A. Campbell, B. Kelly and J. L. Wharton, all of Melbourne; F. C. Howard and B. A. Moulden, both of Adelaide; D. E. McBryde, North-road, Brighton; F. A. Govett, 20 Copthall Ave., E. C.; F. A. Keating, 22 Bishopsgate, E. C.; and W. H. Woodhead, Hyes, Rudgwick, Sussex. The British address is at Pinners Hall, Austin Friars, London, E. C., where W. S. Robinson is the statutory agent.

Chino Copper Co.

The report of the Chino Copper Co., Santa Rita, N. M., for the third quarter of 1916 shows a production of 20,606,723 lb. of copper; 6,883,403 lb. in July, 6,326,116 lb. in August and 7,397,204 lb. in September. Total amount of ore treated was 801,500 tons, or 8,712 tons per day. Average copper content was 1.89%. Recovery per ton was 25.71 lb. There was produced 62,531 dry tons of concentrates averaging 16.48% copper. Aside from that produced in milling, 44,038 lb. of copper was recovered from precipitation plants at the mine. Cost per pound of net copper, after allowing for smelter deductions and crediting miscellaneous income, was 8.17c.

Total income was $3,445,292; dividends paid, $1,957,455; net surplus, $1,487,837. Earnings are based on 25.61c. per lb. for copper. In addition to the regular quarterly dividend of $1.25 per share, an extra of $1 was paid, making a total of $2.25 paid during the quarter.

Katanga Copper

At the annual meeting of Tanganyika Concessions, Ltd., a few weeks ago, Robert Williams, managing director, made interesting statements respecting the performances and position of the Union Miniere du Haut Katanga—the operating company. Mr. Williams said in part:

The Union Miniere company has already made large profits, and although we are still unable to get the interest of these profits, to which we would be entitled in normal times, it is a great satisfaction to know that they are accumulating month by month, and will continue to do so until we return to Brussels, where they can be dealt with. I have made every endeavor to arrange some plan by which the company could get an advance on these profits—so far, without success. It has seemed to me that, as the Belgian government owns about 35% and the Tanganyika company about 40%, or 75% of the Union Miniere company between them, these two large shareholders might arrange a division of profits now, which they could agree to ratify at the first general meeting of the Union Miniere company in Brussels. These are the lines on which I have been negotiating with the Belgian government—so far, without success.

The Union Miniere company's operations have made rapid progress since the war began. When war broke out, I wrote a letter advising my colleagues of the Union Miniere company in Brussels to continue operations, as they seemed on the point of shutting down. Our Belgian colleagues agreed to my suggestion. We started these operations in London without a shilling in the company's coffers. We struggled on in the early days of the war with copper at a price which barely covered the increased expenses. It was a desperate struggle, and had it not been for the credits given us by our own employees, shipping, coal, railway and other companies, we could not possibly have weathered the storm. It was with the greatest difficulty we could sell our copper in any large quantity, but by entering into a contract for the sale of our whole output during the war on the same terms as we had formerly sold our copper in Brussels, we were enabled not only to carry on our works, but to greatly accelerate the erection of another two furnaces and our operations generally.

Increase in Copper Production

Copper has since then gone to a very high price, and as a result we have not only been able to double our furnace plant, but we are actually trebling it, with the result that at no distant date we shall be running seven furnaces, with one spare, instead of the three we started with at the beginning of the war, all of which will be paid for out of profits. The output of copper has gone on steadily increasing, as is shown by the following figures: 1911, 997 tons; 1912, 2,492 tons; 1913, 7,407 tons; 1914, 10,722 tons; 1915, 14,190 tons; 1916, 25,000

tons (estimated); and next year it will probably reach something in the neighborhood of 40,000 tons, provided the Katanga railway is rapidly equipped to deal with the traffic. This railway has been running under very difficult conditions, for want of rolling stock, and it is highly creditable to the management that it has been able to deal with the traffic so well as it has done, and equally creditable to the manager and staff of the Union Miniere company that they have been able to keep up the copper output under the circumstances. The cost of producing copper has been reduced considerably by the latest improved furnaces. These furnaces show a saving of about £5 per ton of copper at the works, which has compensated in some measure for the increased cost of shipping and other charges caused by the war. The cost of copper at the works for 1916 has been: By old furnaces, £27 16s.; by new furnaces, £22 15s.; or an average price of £25 12s. The cost of rail, freight, insurance and sundries has been £15 19s. 3d.; the total cost, delivered in England, £41 11s. 3d. In normal times and with our improved furnaces, this cost would be about £30 per ton. The entire copper production has been sold in England at an average price of £102 for 1916. When I last addressed you, I told you I believed the accumulated profits of the Union Miniere company would be £1,000,000 sterling by the end of 1916. These profits will be about double that figure.

Wheeler Recommends Leaching

Perhaps the most important news I have is that Mr. Wheeler, in his report received a few days ago, states in the most emphatic and clear manner that there will be no difficulty in treating the low-grade ores either by concentrating and smelting or by leaching, and he recommends the leaching process and points out that by leaching we can also produce copper from our high-grade ore cheaper than by smelting; and he also recommends an installation to produce 50,000 tons of electrolytic copper per annum by the application of the hydraulic-power scheme planned by the Swiss engineers sent out by the Union Miniere company some years ago.

The Company's Railway Interests

With regard to the other great asset which your company owns—namely, 90% of the Benguella railway, the other 10% being held by the Portuguese government—I have had various interviews with ministers, contractors and financiers, in connection with this railway, with a view to restarting construction from both ends; namely, from the Katanga side and from the Portuguese side. Up to the present it has been found impossible to get railway material in this country, and the Benguella railway section alone would cost about £1,200,000 extra if it were to be constructed at this time, with material coming from America; but you may depend upon it no time will be lost in carrying this railway to completion right through to the mines by the Belgians and ourselves, at the earliest possible opportunity and when it can be done with efficiency and economy. Meantime you will see from the report of the Benguella Railway Co., which has been handed to you, that that company continues to show an increasing surplus over working expenses from year to year, as is shown by the following comparisons: 1912, £20,955; 1913, £27,672; 1914) year war broke out and traffic down), £15,807; 1915, £44,063; 1916 (six months to June), £22,571. You will also see from Vice-Counsul Beak's report the brilliant prospects he holds out for the future of this railway. As you are aware, the railway is being built to serve Katanga mineral traffic, and it is only when that traffic is running over it that the railway will show the big income we expect from it, which has been estimated at from £280,000 to £600,000 per annum, based on a mineral traffic of 40,000 tons of copper output per annum. I may add that this railway will, when connected to the Belgian Congo railways, add greatly to the paying capacity of these railways, as it will give a much longer haulage over these lines than they at present have. The Rhodesia-Katanga Junction Railway and Mineral Co., in which you are interested to the extent of 70%, has leased its line to the Mashonaland Railway Co. at a rental of £44,000 per annum, which is the sum required for the payment of the former company's debenture interest. Half of any sum earned above that amount is payable to the Rhodesia-Katanga Railway Co. It will thus be seen that while your company is relieved from paying the debenture interest, it is indirectly interested in the profits. The traffic for last year, as you will see, resulted in a profit of £41,066, the falling off in the earnings being due to the present conditions, in consequence of which there was a decrease in the general goods and construction material and also in the passenger traffic. An improvement, however, has already been made this year, and the figures to the end of August last show a profit for the eight months of about £47,000.

Smelting Operations

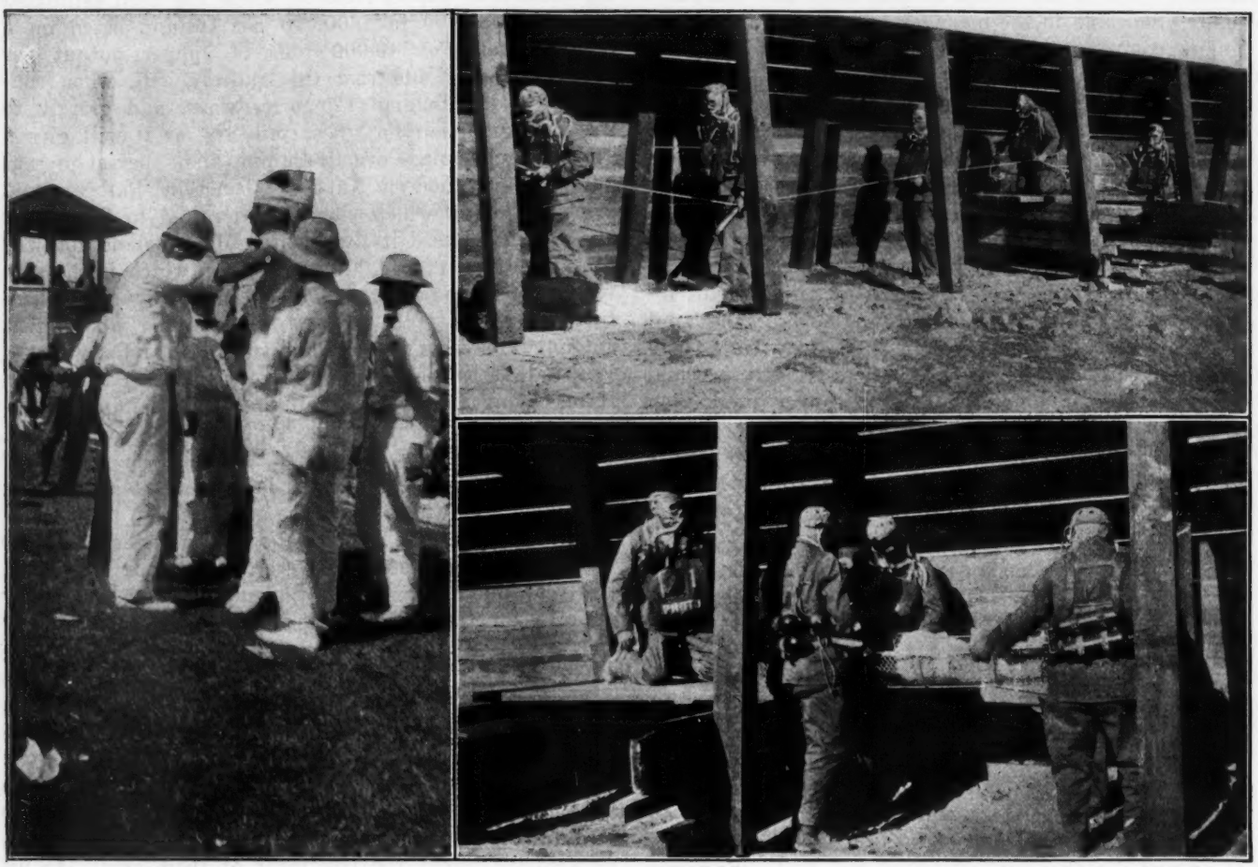
We have not restarted smelting at the Kansanshi mine, as in the present circumstances it is quite impossible to get the necessary white and black labor to restart work on the high-grade ore, but when the time comes to continue smelting, I hope to be able to also have a plant for treating the low-grade ore, which will give good results, as we have solved the treatment of these ores. As we control the Rhodesia-Katanga company, the advances made to that company by us will be repaid as the copper is produced and sold. We intend restarting the production of copper next spring at this mine, if labor and other conditions are fovorable.

Ray Consolidated Copper Co.

The report of the Ray Consolidated Copper Co. for the third quarter of 1916 shows a total production of 19,061,727 lb. of copper; 6,606,657 in July, 6,400,636 in August and 6,054,434 in September. In addition to copper from concentrating ores, 620,734 lb. was contained in ores shipped direct to smelter. Total ore milled was 849,400 dry tons averaging 1.571% copper. Milling cost was 54.99c. per ton, and average mining and coarse crushing costs were 83.77c. per ton.

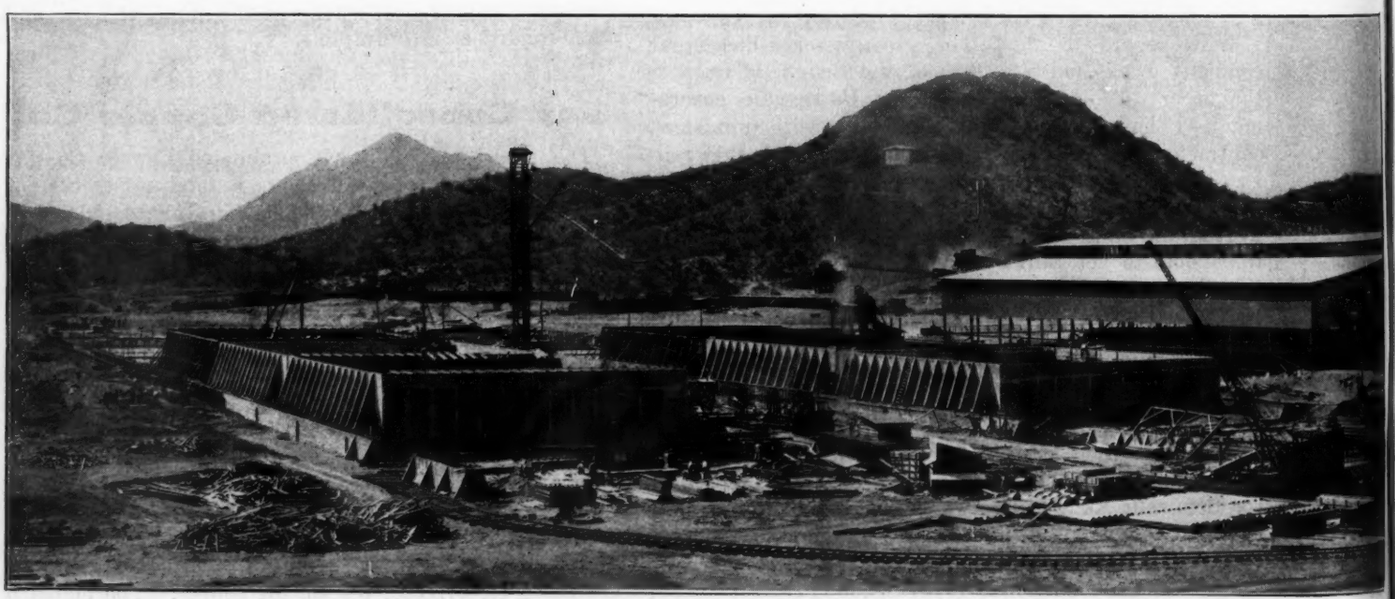
Average cost per pound of net copper produced was 10.348c., including a charge of 12½c. per ton of ore milled for retirement of mine-development expense, but after crediting dividends of the Ray & Gila Valley R.R., revenues from gold and silver, and all miscellaneous income. Total profit was $3,299,400; dividends paid, $1,182,884, leaving a net surplus of $2,116,516. Earnings are based on 27.722c. per lb. for copper. The eleventh quarterly dividend of 75c. per share was paid.

Photographs from the Field

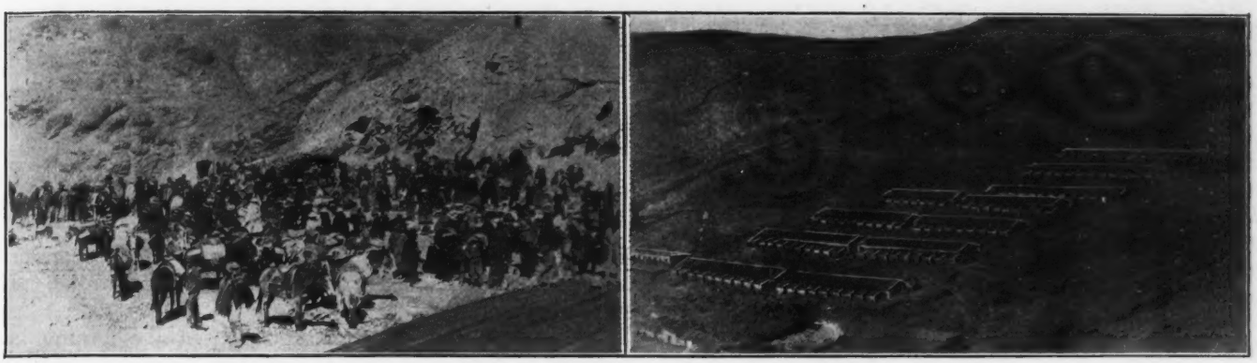


EMPIRE MINES' MINE-RESCUE TEAM WON FIRST PRIZE AT CALIFORNIA STATE FAIR

The mine-rescue team was composed of R. W. Rodda, T. Evely, C. Oates, F. Carter and F. Hooper. The Empire Mines' first-aid team won second prize in the first-aid contest; it is composed of J. Luzmoor, J. Ball, J. A. Hendricks and J. Quick; L. Prisk is the "patient"

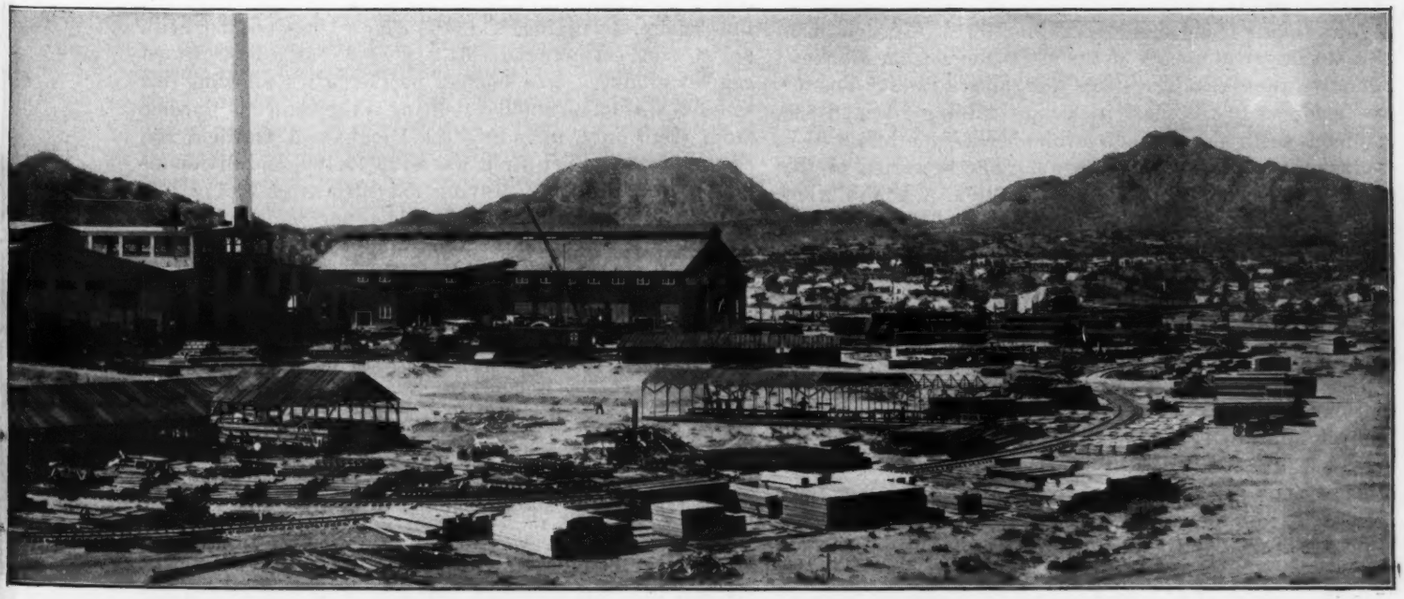


PANORAMIC VIEW—TAKEN SEPT. 16—OF 5,000-TON LEACHING PLANT UNDER



PAY DAY AND MINERS' HOMES AT ONE OF THE PATIÑO TIN MINES, UNCIA, BOLIVIA

CRUSHED-ORE STORAGE BINS AT FEDERAL LEAD CO., FLAT RIVER, MO.



CONSTRUCTION IN AJO DISTRICT, ARIZONA, FOR NEW CORNELIA COPPER CO.

The American Mining Congress

That the anthracite operators are opposed to uniform mining legislation and that the Northwest Mining Association is convinced that politics is playing a part in the location of the mining experiment station for the Northwest, were two of the important developments of the first day's session of the American Mining Congress. A representative assemblage of mining men from all the important coal- and metal producing states is taking the keenest interest in the sessions of the Congress which was called to order this morning.

Interest at the morning session was concentrated on the meeting of the Uniform Mining Legislation Section. After J. G. Grossberg, of Chicago, had explained that the meeting was called with the hope that uniform mining legislation might be pressed from a conversational stage to one more promising of results Robert H. Harlin, of Seattle, representing the United Mine Workers of America, pointed out the evils of allowing the mines inspection service to be at the mercy of the political whims of each change in state administrations. He also urged that all mine foremen be required to pass a technical examination before being allowed to go on duty. He also contended that it is highly necessary for mine superintendents to be obligated to take the same examinations as the mine foremen.

During the discussion of Mr. Harlin's paper the opposition of the anthracite operators to the plan for uniform legislation developed. It seems the consensus of opinion among the operators of anthracite mines that the conditions surrounding their industry are so dissimilar that it would be impracticable to attempt to frame a set of laws which would apply to the bituminous coal industry without imposing undesirable restraints on the mining of hard coal. George S. Rice, Chief Mining Engineer of the United States Bureau of Mines, at this point, expressed the firm conviction that there are certain fundamentals which apply equally and without discrimination to the bituminous and to the anthracite industry. H. H. Stoek, of Urbana, Ill., also expressed the opinion that uniform legislation is entirely feasible, and he pointed out that the need was so great as to make some action at this meeting very desirable.

Addresses of welcome from prominent Chicago men took up the greater part of the afternoon session Monday, but when the roll of the states was called to which answer was made as to the most important mining issue in the commonwealth designated, a number of matters which excited lively discussion came up. The sensation of the afternoon, however, was the presentation of a resolution by the Northwest Mining Association, represented at the convention by Sidney Norman. Despite the fact that official announcement has not been made as to the location of the Northwest Mining Experiment Station, the resolution took it for granted that Seattle had been designated. The resolution stated that politics evidently is playing a part in the location of the Northwestern station. Mr. Norman declares that Seattle is 500 mi. from any important mining region in continental United States and that its principal tributary territory is Alaska, which already has a station at Fairbanks. Due to the fact that all but 2% of the mineral production of the Northwest is produced west of the mountains, Mr. Norman contends that the station should be at Wallace or some other point near the centers of big productions.

In the responses from the states a frequent complaint was that too many laws are hampering the industry. Nearly every coal mining state, according to its representatives, is seriously in need of a system of uniform cost accounting. W. S. Bogle, an Indiana operator, made an earnest plea for the removal of legal obstacles preventing limited coöperation among those engaged in any business. He praised the broad view taken by the Federal Trade Commission on this question.

A resolution based on replies from mine operators from Tennessee was presented by A. H. Purdue. It reads as follows:

"Resolved that the greatest needs of the mining industry in Tennessee are: Coöperation among coal-mining operators, under proper control, for the purpose of securing reasonable prices; the removal of the state convicts from the mines or the state becoming a party to the proposed coöperation; a uniform system of cost accounting for the operators; improved railroad facilities into the coal field, and the area to the south and southeast, including the seaboard; and the development of the state's manufacturing industries to provide a home market for its mineral resources."

Dr. I. C. White, Chief Geologist of West Virginia, predicted that within 5 years his state would produce more bituminous coal than Pennsylvania. The crying needs at present are for more markets for coal within the state and for more coal carrying rolling stock.

Minnesota, while entirely satisfied with the development of its iron-ore tonnage, believes that the profits are not equally divided between the producers of the raw material and the manufacturers of the finished products.

South Dakota entered a bitter protest at not being able to share in the general prosperity which is coming to other mining states. With the purchasing power of gold depreciated 30%, the principal mining activity in South Dakota is laboring under a handicap.

Utah Copper Co.

The report of the Utah Copper Co. for the third quarter of 1916 shows a total production of 61,079,924 lb. of copper; 20,302,228 lb. in July, 20,315,440 lb. in August and 20,462,256 lb. in September. A total of 3,404,300 tons of ore, averaging 1.4484% copper, was treated, with an average extraction of 61.94%. Average cost of net copper produced was 6.322c. per lb. after allowing for smelter deductions and crediting miscellaneous income from Utah only, including the Bingham & Garfield Ry. earnings. Total net profit was $12,049,460, and dividends paid were $4,873,470, leaving net surplus of $7,175,990.

Earnings are based on 25,364c. per lb. for copper. The regular dividend at the rate of $6 per year was paid and an extra dividend of $1.50 per share, making a total of $3 per share for the quarter.

Gold Value of the Far Eastern Rand, where prospected, is conservatively estimated as £450,000,000 by the government mining expert, Mr. Katze. The "Statist," of London, quotes the above figure in a recent article dealing with the importance of the region; calling attention to the fact that the ordinary run of investors in the shares of gold companies, who fix their eyes on their own pet investment, ignore the vastness of the whole proposition. The value of total gold yield of the region, from start of milling to Dec. 31, 1915, is given as £29,700,000. The total value of gold output of the Witwatersrand since discovery to Dec. 31, 1915, is given as about £454,000,000; the inference being that the future of the newer region may prove as interesting as the past of the Rand proper.

Editorials

Selling Ahead

The new practice of selling metals for delivery far ahead is going to be productive of some complications that may not be pleasant later. It has long been the custom in copper and spelter to do the business on the basis of two-month and three-month contracts. The common terms in lead, on the other hand, have been "shipment within 30 days." During the last two years, however, copper and spelter have been repeatedly sold a year ahead. Of late some business has been done in copper extending to the end of 1917.

The ideas about this are manifold. On the part of the manufacturer, if he has contracts for his own products running a year ahead he may be desirous of covering his requirements of raw material therefor and getting that off his mind. In munitions contracts with foreign governments there is no particular danger of welching on the part of their customers. For that matter, indeed, private buyers are in the main animated by the highest principles of business. If they find themselves caught in the results of bad judgment they face the music.

In the early days of the munition business there were contracts given to some new and rather irresponsible concerns, who were regarded dubiously when they came to placing their orders for copper, not so much from any question as to their good faith but rather upon the chance that they might fail in their contracts. We heard of some such copper business being taken at a premium that was considered to compensate for the risk. In general, however, the major metal business is so conducted that losses from bad debts or failure to meet obligations are negligible.

The producers who sell far ahead sow dragon's teeth of quite a different sort. If one producer be smart enough to sell all of his output for a year ahead he may stand off and rejoice. If all producers should sell all of their output for a year ahead they might do likewise. But if most producers dispose of only a part of their output the day of reckoning is sure to come. That is when the craze for buying is over, when consumers find that they have overbought and themselves come into the market as sellers and create demoralization.

What we are witnessing now in copper is exactly what we did in zinc about 12 to 15 months ago. At that time the zinc producers had disposed of most of their expected output for months ahead. It looked as though there were going to be a zinc famine, as if many consumers would have to go without their supplies. But somehow or other they managed to get what they needed and before the middle of 1916 consumers of zinc were themselves sellers and there was something like demoralization in the spelter market.

During the last week near-by copper has sold at 32½c. per lb., a sharp rise from the previous week, indicating the apparent scarcity of it and the urgency of the demand for it. It has been gossiped, however, that the foreign governments, delayed in securing transportation for all that they had previously bought, have been meeting the demand and covering themselves by new purchases for later delivery. Whether true or not, it is just such things that check extravagance and abolish the premium on near-by deliveries. It would be rather a grim joke on the American copper industry if the foreign governments were making a profit by supplying at fancy prices domestic consumers who had overstayed their market.

Has Unionization Made Miners More Efficient?

In the October issue of the *Mining Congress Journal*. S. A. Driver answers certain arguments of the vice-president of the United Mine Workers of America regarding some earlier criticism of the attitude of unionism to the individual responsibility and efficiency of the mine workers. The union official claims that statistics show that the loss of life is about three times as great in the nonunion as it is in the union mines and that this ought to be proof positive that the U. M. W. of A. is one of the greatest agencies in the country today for the promotion of safety in mines. Mr. Driver considers that the statistician who furnished the figures on which Frank J. Hayes based his statement made a most serious error in his work.

Mr. Driver quotes figures from Bulletin 115 of the United States Bureau of Mines[1] tending to show that the deaths due to common accidents in coal mines, from 1903 to 1913 inclusive (excepting 1909), when reduced to a basis of 2,000 working hours, average about the same for six union states as for six nonunion states. He also quotes statistics compiled by Mr. Fay, showing that for a period ending Dec. 31, 1915, for which continuous records are available, there were killed by explosives for each 10,000 employees in Oklahoma, 8.60; Illinois, 3.40; Indiana, 4.20; Kansas, 6.81; Alabama, 2.70; and Colorado, 2.25; the first four being union states and the last two nonunion states.

In conclusion Mr. Driver says: "The mine-workers' organization has among its various local and general officials many men of unusual mental capacity, among whom are born leaders of men. When they devote their talents and energies to making the miner a safer and more efficient workman, a better man and citizen, the miners' union will become one of the most powerful agencies for good in the industrial world. But at present I see no reason to change my belief that its principal tenet is, *Do less and ask more for it.*"

A mere comparison of fatility rates may be useful as a measure of efficiency as regards the promotion of safety at mines, but a proper conception of efficiency should take into account the factor of production. In this connection Mr. Driver asserts (doubtless with truth and the ability to confirm the statement) that the Welsh

[1] "Coal Mine Fatalities in the United States, 1870-1914," compiled by Albert H. Fay.

miner as an individual workman is the peer of any miner in the world, but that the production per man is among the smallest in the world, the miner's union preventing his realizing the proper return on his ability and skill.

The question propounded in the caption is not one that can be answered by statistics. Figures do not lie, but skillful selection of statistics is an aid to prevaricators. The question of unionism and efficiency must be decided by each individual workman and by each employer. If the respective conclusions harmonize, the interference of any external union or nonunion influence is unwarranted and is likely to reduce efficiency, both as regards safety and production.

In this whole matter there is much food for serious thought on the part of the laboring man. Where there exists between employers a competition for the services of laborers, the result is obviously beneficial to the laborers. Where there is competition between two or more labor unions for the handling of the large sums of money represented by the weekly or monthly dues assessed upon the individual laborers (and of late some agitators have brazenly confessed such motives), the only benefit likely to accrue to the laborer is that derived from waking up to the realization that he has not been getting value received. For then he begins seriously to ask himself: "Has the union taught me to be a better miner? Has the walking delegate shown me how I can produce better results with less physical labor and less danger to myself and my fellow employees? Has the secretary of my local instructed me as to how I may win the respect and admiration of my employer and has he taught me that I should be loyal to my employer?" If the answer be affirmative in every case, then he will know in his heart that unionization has made him more efficient.

Construction, Operation and Maintenance

The construction of a mine plant, mill or smeltery is usually carried out according to plans and specifications evolved from a more or less standard practice for the many component parts. However, standard practice is often stand-pat practice and more or less indigenous to one locality. What is standard in one camp may not be applicable to another. In other words, every plant built differs in one or more details from any similar plant, even though the process for which it is built has been thoroughly standardized. This condition causes many minor changes in details during construction to adapt the practice to suit the local conditions. Foundations may not be feasibly put in according to plans. Piping diagrams often have to be switched around. Trackage cannot always be put in just as laid out. Drains may have to be changed. These are only a few of the minor details that come up in the course of the work.

In the construction of large plants or the addition of units to existing plants, the work is usually performed under the supervision of a resident engineer whose orders—in the form of plans and specifications—emanate from headquarters. He is thus on a par with the plant manager and has for his object the addition of capacity to assist the manager in producing a greater quantity of product. The engineer and his assistants are primarily construction engineers, true to the maxim, "Get the plant built." Its future successful operation is in the hands of the manager and his assistant, who live by the motto, "Turn out the product." Any suggestion from the operating department in regard to minor changes, based on experience, is received most coldly by the construction department. It is annoying, when you are rushing the fifteenth unit to completion, to go back and change the slope in the launders in the seventh, which has just been put in operation, or to renew some piping in the second, which has proved defective after several months of operation. It is usually the policy of the construction department to fall back on the fact that the launders were built "according to the blueprints," and refer the manager to headquarters. After much red tape the manager may succeed in having the change made, much to the annoyance of the engineer, who usually performs the work in as slipshod and hurried a manner as possible.

It seems senseless to build a plant and immediately start to alter it, sometimes even before it is in operation. Of course it is easy to say that the engineer should understand the details of operation for which the plant is built well enough to ferret out probable faults in design and arrange for their correction before that point in the construction is reached. Frequent inspections of the work in company with the manager would tend to reduce the necessity for later alterations. However, anyone who has ever been engaged in plant construction knows that this is impossible. Construction is the proper combination of men, material and time. This presents a problem of three variables, the solution of which gives the engineer no time for the contemplation of the future felicity of operation. When inspecting the progress of work on a mill, he does not think whether the launders will choke on the particular type of sand to be produced or whether the belting is the proper size. His mind is filled with whether all the shafting is in place, whether the throughbolts have come yet, etc.

Similarly, the manager of the units already in operation is too busy with his details to spend much time going over the progress of work in the new areas. All he wants to know is when he can put new parts into operation to increase his capacity.

It seems from these facts that there is something lacking in the organization of large plants. Someone is needed who is thoroughly familiar with all the details of operation and at the same time all the limits of construction. He should investigate all the suggestions of the manager and make all the recommendations to the engineer. He should be present continually during construction and should keep track of the plans far enough ahead to make changes in them before the time of the construction. The less standard the plant the greater should be his powers and the greater his ability. He should be the connecting link between the organizations of the two departments and should endeavor to blend them without interfering with their specific and divergent objects.

At the completion of construction, that is, when everything is built "according to the plans," he becomes a separate oragnization—the maintenance department. His motto becomes, "keep the plant running." It is his job to tell when boiler tubes need renewing, when stacks need cleaning or bearings need rebabbitting. It is up to him to make such changes as are suggested by wider experience. It has been shown by experience that maintenance is disregarded until the end of construction with

attendant friction, changes and delays. The maintenance department in an advisory capacity should be always present and should take up its work actively immediately at the conclusion of construction. Much better could the maintenance department change the slope of that launder in the seventh unit and renew the leaky piping in the second than the overworked construction department.

Of course, the smaller the plant the smaller the organization and the consequent merging of the construction, operating and maintenance departments under the supervision of the manager. In the small organizations all the pitfalls mentioned melt under the guiding hand of the manager. He builds as necessary, realizing the requirements of what he is building and keeps in order what is already running and keeps his production up to the average. In large organizations, however, the maintenance department should have a distinct place as soon as work is started on the plant. As soon as units are completed by the construction department the maintenance department should be responsible for them.

⁂

The Great Falls zinc electrolytic plant of the Anaconda Copper Mining Co. is going into operation unit by unit and already is turning out a good deal of spelter, all of which is high-grade. The expected output was sold a long way ahead before the plant went into operation, so the company does not figure much in the market at present. There seems to be but an imperfect realization of what a large zinc producer the Anaconda is going to be.

⁂

It is about time for another revolution in Mexico, anyway. Therefore the reports of a recrudescence of the irrepressible Villa and of the preparations of Carranza for a change are not surprising. The joint commission that has been sitting at New London and Atlantic City continues to sit, but nobody expects anything of it, and the hopes of wheedling wicked Wall Street into lending Carranza a hundred million or so are not bright.

⁂

One of the war commodities that has come down to earth again is sulphuric acid. In the acute period this fetched $50@60 per ton. Ordinary tower acid is now down to about $7@8 per ton, which is only a trifle in excess of what it used to be in normal times. The explanation is increased production. The consumption is still very large.

⁂

Again the threat of a railway strike is looming. The railways have been instituting actions to test the legality of the Adamson law. The brotherhoods have told them to drop those actions or face a strike on Jan. 1. Under the new tyranny the railways may not have the ancient Anglo-Saxon right of a day in court.

⁂

Present prices for copper are without any doubt the highest on record. The higher prices quoted during the Civil War were measured by a depreciated currency.

⁂

Now that the political contest is over the public is being informed what was previously known in business circles, viz., that the situation in Mexico is again very alarming.

BY THE WAY

The following simple formula was given in *Iron Age* and is intended for use in finding the individual wage rates of employees:

$$V = \left[K\left(\frac{[B(1 + i + m + ny) + R](1 \pm 2e)}{r(1 + 1.3E \mp 0.3e)(1 + 0.3P_a) + s} \times P_t + \frac{[B(1 + i + m + ny) + R](1 \pm e)}{r(1 \pm 0.6)(E \mp e)(1 + 0.3P_a) + s} \times P_d + \frac{B(1 + i + m + ny)}{r} \times P_l\right)\right] C$$

It appears to include the majority of the entering factors, and any that are omitted may be conveniently lumped either in K or C, the two "extreme" constants.

⁂

The murder of five Americans at Parral, Mex., is reported in an El Paso dispatch of Nov. 14. The information is said to have come from a source considered reliable by Gen. George Bell and was to the effect that when the Carranza commander retired from the city, he suggested that the Americans in Parral accompany him. Four did but five Americans who remained were arrested by the Villista commander, marched to the plaza and executed. The dispatch states that "Americans known to have been in Parral at time Villistas attacked were: T. G. Hawkins, A. W. Morris, Leslie Webb and Howard Gray, Alvarado Mining and Milling Co.; W. E. Palmer of Parral & Durango Ry.; Dr. T. J. Flannigan, W. E. Cowell of Guadelupe Mining Co.; C. B. Smith, and an American, whose name is unknown at the border."

⁂

Again the German submarine "Deutschland" is with us and again there are all sorts of rumors about the cargo she is going to take back to Germany. Nobody knows definitely anything about the real truth of this matter, but the *Providence Journal* claims to know, and is making public a lot of things that might be considered, in general, secrets. The *Journal* says it has secured many details concerning the cargo, and that it will consist of nine carloads of nickel, averaging 40 tons to a car, and 10 carloads of crude rubber, averaging 18 tons to a car, making a total shipment of 540 tons. According to the same source of information, there still remains in the warehouses of the Eastern Forwarding Co., of New London, a consignment of over 400 tons of crude rubber, and 200 tons of refined nickel, which is apparently stored for export by another submarine. All the nickel aboard the "Deutschland" is said to be part of a consignment purchased in November, 1914, from the International Nickel Co., at Communipaw, N. J. The *Journal* discovered that this consignment was taken by the purchasers, ostensibly German-Americans, but really men acting for the German government in this country, and transported to the storehouses of the Nassau Smelting and Refining Co. at the foot of West 29th St., North River, New York. The nickel was then transferred at various times to the New York Dock Co., in Brooklyn, where it was stored in warehouse No. 104 and placed in casks weighing from 900 to 1,400 lb. The metal was partially in ingots and largely in a form about the size of buckshot. The nickel intended for the voyage of the "Deutschland," last July, was shipped to Baltimore via Pittsburgh. The next movement of the nickel which remained after the first departure, came in the beginning of last September, and soon afterward a number of carload lots were received by the Eastern Forwarding Co., in New London.

Personals

H. F. Collins has returned from Spain and is now in London, Eng.

Ernest Marquardt, of the Associated Geological Engineers, is in Kansas.

C. T. Griswold, of the Associated Geological Engineers, is in Wyoming.

J. J. Remsen has returned from a trip to Cobalt and the Temiskaming region.

J. K. Cogswell is at the St. Anthony mine, near Fort William, Ontario, Canada.

Roger L. Wensley, of New York, is in the Southwest on professional business.

H. D. Kinney has become associated with the Mines Operating Co., at Butte, Mont.

D. W. Buckby, of Wallace, Idaho, is visiting New York. He is at the Hotel McAlpin.

L. G. E. Bignell has become one of the engineering staff of the Colorado Iron Works Co.

J. W. Astley sailed from Liverpool on Nov. 11 for New York. He will be in the city about ten days.

W. Lee Tanner is chief chemist of the Bethlehem Steel Co. at its high-explosive plant, New Castle, Del.

C. M. Weld left New York for Cuba on Nov. 14. He will be there on professional business for about two weeks.

H. P. Henderson left New York on Nov. 14 for a short visit of inspection in Quebec. He will return about Nov. 20.

H. F. E. Gamm, of New York, is at Mine La Motte, Mo., where he expects to remain for several months on professional business.

Ray W. Light, of Lebanon, Penn., has been made superintedent of the bessemer department of the Cambria Steel Co., at Johnstown.

W. D. Thornton, president of the Greene Consolidated Copper Co., succeeds Thomas F. Cole as president of the Greene-Cananea Copper Co.

Edward A. Clark has withdrawn from the firm of Giles & Clark, the Giles Drilling Co., 30 Church St., New York, taking over the business.

John F. Martin has again returned to Nicaragua, after an absence of several years, as manager of La Luz & Los Angeles Mining Co. in the Prinzapolka district.

Lieutenant H. T. Durant, of the 11th Hants Regiment, is back in England from France. He lately received the honor of the military cross for services on the Somme.

L. W. Trumbull, state geologist of Wyoming, is at the convention of the American Mining Congress losing no opportunity to present the Western idea of the conservation question.

E. A. Suverkrop, Jr., and bride will sail from New York on Nov. 18 for Chile, where he will again be on the operating staff of the Chile Exploration Co. at Chuquicamata.

John Francis Manning and Edwin Walter Mills, of the Seoul Mining Co., of Chosen, are making a long visit in the United States, from which they have been absent for a good many years.

T. C. Desollars, chief engineer of the Quincy Mining Co., of Hancock, Mich., is at the Mining Congress convention to outline the efficiency and safety system which are being used at the Quincy property.

Max Ball, of the Bureau of Mines, will stop in Chicago to attend the convention of the American Mining Congress while enroute from an inspection trip to Western oil fields to his office in Washington.

F. M. Wichman, for a number of years superintendent of the Bingham-New Haven mine at Bingham, Utah, and recently operating in Nevada City, Calif., is visiting the East. His temporary address is Montclair, N. J.

H. G. Ferguson, a geologist of the Geological Survey who is now engaged in work in the Mogollon district, will make an examination of Steeple Rock gold, silver and lead district of New Mexico before returning to Washington.

Thomas F. Cole has resigned the presidency and directorate of the Greene-Cananea Copper Co., and the board of the Inspiration Consolidated Copper Co. Mr. Cole has held the presidency of the Green-Cananea company since its organization, eight years ago.

F. L. Ransome, in charge of the section of metalliferous deposits of the Geological Survey, has returned from a two months' tour of Western mining camps. On this trip Mr. Ransome visited the Alta, Bisbee, Miami, Ray, Ajo, Mogollon and Magdalena mining districts. In the Ajo district Mr. Ransome laid out the boundaries of the topographic map of the district which is soon to be begun.

David White, chief geologist of the United States Geological Survey, has returned from an extended trip through the oil and gas fields of Oklahoma and Arkansas. One of the objects of Mr. White's trip was to make more effective the efforts being made by the Geological Survey to secure cuttings from wells and samples of brines in the region of heavy salt beds and gypsum depositions in Oklahoma.

George S. Rice, chief mining engineer of the U. S. Bureau of Mines, was in San Francisco, Oct. 25-28, arranging for a successor to Edwin Higgins, representative of the Bureau of Mines in the California Industrial Accident Commission. Mr. Rice went to Los Angeles on Oct. 28 and will return to Washington about Nov. 15, stopping en route to visit mining centers where field investigations are in progress.

Deane P. Mitchell, mining engineer, Stanford '95, has returned to San Francisco from Siberia. Mr. Mitchell is a director of the Irtysh Corporation Ltd., developing and operating copper, zinc, lead and coal mines on the Kirghiz Steppe, southern Siberia. He believes that after the European war Siberia will rapidly develop and increase in population, attracted by unlimited natural resources and great waterways.

Sir Richard A. S. Redmayne, chief mine inspector for Great Britain, and president of the Institution of Mining and Metallurgy, has resigned the latter office, in which he will be succeeded by Edgar Taylor, past president and treasurer, who will fill out the unexpired term—to March, 1917. The action was taken in view of the Institution's inquiry into the taxation of mining profits and its proposal for the formation of a governmental department of minerals and metals, the president regarding his position as incompatible under the circumstances with his duties as a government official.

Obituary

Emil Storer, 72 years of age, secretary and treasurer of the South Hecla Mining Co. and other mining companies in the Little Cottonwood district, died at St. Mark's Hospital, Salt Lake City, Nov. 4, 1916. The case was one of unusual and puzzling features. Mr. Storer, who was a man of considerable wealth, lost the sight of one of his eyes Tuesday. On Friday the other eye became sightless. Dr. H. Van Cott, eye specialist, was called. Dr. Van Cott said that death was undoubtedly due to an acute inflammation of the eyes. He thought that Mr. Storer had been affected with trouble of the eyes for a considerable time, but had probably not thought it serious enough to seek medical advice. The doctor declared that great pressure on the eyes was evident, otherwise Mr. Storer would not have been stricken blind. Mr. Storer came to Utah about eighteen years ago from Indianapolis. Besides Little Cottonwood properties, he was interested in many other mining camps in Utah and Nevada. He also was widely known in the West and had a wide circle of warm friends.

Societies

Mining and Metallurgical Society of America—The New York section held a meeting at the Engineers' Club, New York, on Thursday, Nov. 16, at 8 p.m., preceded by the usual dinner at 6:30 p.m. The subject was "Electric Furnace Practice."

American Institute of Mining Engineers—The sixth annual meeting of the Columbia Section, A. I. M. E., will be held at the Spokane Hotel, Spokane, Wash., Nov. 25. A dinner will be served to the members, after which the program will be followed. This includes the address of the retiring chairman, Stanly A. Easton, report of the secretary-treasurer, L. K. Armstrong, election of officers, their installation, and discussion of the mining law revision, flotation and other subjects of technical interest.

American Society of Mechanical Engineers—The 37th annual meeting will be held at New York, Dec. 5 to 8, 1916. A program of interesting technical papers has been prepared. Following the meeting, a public hearing will be held on the Boiler Code, Friday, Dec. 8, at 2 p.m., in the Engineering Societies Building. The hearing will continue on Saturday and into the following week, if necessary.

This hearing is in pursuance to the following recommendation of the boiler code committee to the council: "Your committee recommends that you appoint a permanent committee to make such revisions as may be found desirable in these rules, and to modify them as the state of the art advances, and that such committee should hold meetings at least once in two years at which all interested parties may be heard."

Industrial News

B. A. Brennan, formerly contract manager of the Westinghouse Machine Co. and later sales manager of the power department of the Bethlehem Steel Co., has resigned the vice-presidency of Mercantile Trust Co., of St. Louis, Mo., to accept the presidency of the Citizens Co., Inc., of Baltimore.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Agitator for Ore Treatment. Cyrus Robinson, Mount Vernon, N. Y., assignor to Metallurgical Engineering and Process Corporation. (U. S. No. 1,204,069; Nov. 7, 1916.)

Amalgamator. Willon Percival Alderson, Timmins, Ont. (U. S. No. 1,204,231; Nov. 7, 1916.)

Concentration—Mining Machine. Sophus P. C. Borson, Salida, Colo. (U. S. No. 1,203,573; Nov. 7, 1916.)

Concentrator. Lynn W. Barber, Hetland, S. D. (U. S. No. 1,204,333; Nov. 7, 1916.)

Crusher—Gyratory Crusher. Owen E. Brown, Wilmington, Del., assignor to American Manganese Steel Co., Augusta, Me. (U. S. No. 1,202,790; Oct. 31, 1916.)

Crushing Roll. Ray C. Newhouse, Milwaukee, Wis., assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (U. S. No. 1,203,901; Nov. 7, 1916.)

Dipper Tooth. John O'Fallon Clark, Jr., St. Louis, Mo., assignor to American Manganese Steel Co., Augusta, Me. (U. S. No. 1,202,806; Oct. 31, 1916.)

Drill—Rock Drill. Daniel S. Waugh, Denver, Colo., assignor to the Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,203,284; Oct. 31, 1916.)

Flotation—Separation of Metallic Sulphide Ores. Fleury James Lyster, Broken Hill, N. S. W., assignor, by mesne assignments, to Minerals Separation American Syndicate (1913) Ltd., London, England. (U. S. No. 1,203,372; Oct. 31, 1916.)

Furnace-Feeding Device—Automatic Feeding Device for Furnaces. Percy Q. Williams, Cincinnati, Ohio, assignor to the Charles Boldt Co., Cincinnati, Ohio. (U. S. No. 1,201,664; Oct. 17, 1916.)

Induction Furnace. James R. Wyatt, Philadelphia, Penn., assignor to the Ajax Metal Co., Inc., Philadelphia, Penn. (U. S. No. 1,201,671; Oct. 17, 1916.)

Lamp—Miner's Acetylene Lamp. Augie L. Hansen, Evanston, Ill., assignor to Justrite Manufacturing Co., Chicago, Ill. (U. S. No. 1,202,514; Oct. 24, 1916.)

Roasting—Ore-Roasting Furnace. John Harris, Sheffield, England. (U. S. No. 1,203,613; Nov. 7, 1916.)

Separation—Process of Gravity Liquid Separation of Iron Ores. Arthur J. Moxham, Wilmington, Del. (U. S. No. 1,203,897; Nov. 7, 1916.)

Assessments

Company	Delinq.	Sale	Amt.
Big Cottonwood, Utah	Nov. 6	Nov. 24	$0.01
Blue Bull, Nev	Oct. 16	Nov. 20	0.01
Blue Star, Ida	Sept. 25	Nov. 21	0.02
Buffalo, Ida	Nov. 15	Dec. 12	0.005
Cedar Creek, Ida	Oct. 23	Nov. 23	0.01
Christmas, Utah	Nov. 20	Dec. 16	0.005
Comet, Ida	Oct. 20	Nov. 20	0.00075
Confidence Silver, Nev	Nov. 8	Nov. 29	0.10
Cornet, Ida	Oct. 20	Nov. 20	0.00075
Cottonwood King, Utah	Nov. 14	Dec. 1	0.005
Cumapah, Utah	Nov. 8	Nov. 25	0.01
Diam. Blk., Butte, Nev	Oct. 12	Nov. 18	0.01
Diamondfield Bl'k B'tte, Nev.	Oct. 12	Nov. 18	0.01
Duluth, Ida	Oct. 18	Nov. 18	0.001
Emerald, Utah	Nov. 15	Dec. 9	0.00½
Enterprise, Ida	Oct. 19	Nov. 20	0.002
Friend, Ida	Oct. 21	Nov. 24	0.002
Hale and Norcross, Nev	Nov. 8	Nov. 29	0.03
Idaho & L. A., Ida	Oct. 16	Nov. 17	0.005
Idaho Mont, Ida	Oct. 30	Nov. 18	0.002
Idaho-Nevada, Idaho	Nov. 15	Dec. 16	0.002
Lehi Tintic, Utah	Nov. 8	Dec. 2	0.0025
LeRoy, Ida	Oct. 28	Nov. 28	0.005
Lion Gold, Utah	Nov. 13	Dec. 5	0.0025
Mary Ellen, Utah	Nov. 11	Nov. 28	0.001
Mexico G. & S., Nev	Nov. 25	Dec. 18	0.10
Military, Ida	Oct. 25	Nov. 25	0.00025
Mines Dev., Utah	Nov. 17	Dec. 7	0.30
Monarch-Pitt., Nev	Oct. 23	Nov. 27	0.01
Naildriver, Utah	Nov. 4	Dec. 4	0.01
Nevada-Stewart, Ida	Oct. 2	Dec. 2	0.002
New Hope, Ida	Oct. 11	Dec. 11	0.002
Nonpareil, Ida	Oct. 23	Nov. 23	0.001
North Franklin, Ida	June 19	Nov. 23	0.005
North Star, Ida	Oct. 10	Dec. 5	0.001
Paloma, Utah			0.015
Pittsburgh Cons., Utah	Nov. 17	Dec. 8	0.0175
Raven, Ida	Oct. 23	Nov. 20	0.001
Rico-Argentine, Colo	Nov. 18	Dec. 5	0.01
Seg. Belcher & Midas, Nev	Oct. 30	Nov. 24	0.02
Selma, Utah	Nov. 4	Nov. 23	0.005
Silver Moon, Ida	Nov. 25	Dec. 23	0.005
Silver Mt., Ida	Oct. 21	Nov. 24	0.002
Sonora, Ida	Nov. 15	Dec. 6	0.004
Tobar, Nev	Nov. 2	Nov. 23	0.002
Torino, Ida	Oct. 20	Nov. 20	0.001
United Tintic, Utah	Nov. 11	Nov. 28	0.005
Utah Arizona, Ariz	Oct. 31	Nov. 25	0.005
Utah United, Utah	Nov. 15	Dec. 4	0.01
Zuma, Utah	Oct. 30	Nov. 30	0.005

Editorial Correspondence

SAN FRANCISCO—Nov. 8

East Belt Mines, in Tuolumne County, are unusually active. Ten or more properties are now in operation. Columbus at Cherokee will deepen its main shaft to 500 ft. Carlotta mill stamps are dropping on good ore recently developed. Garfield mine, near Tuolumne, has contracted for 200 ft. of sinking. The Confidence will soon resume operation. The Duffield, at Arrastraville, is under option and the tunnel is being cleaned out. North Star is preparing for extensive development. United Mines Co., near Tuolumne, is reported to be under negotiation with mining operators now interested in other parts of the country.

Production of Tungsten Ore and concentrates in California and western Nevada has declined on account of the reduced price and inactivity of the market. In the first half of October the mill at Atolia was running one 8-hr. shift a day and a number of small deposits were being worked in the Atolia district in San Bernardino County. The mines at Bishop, Inyo County, were extracting and treating ore regularly and the mill at Sodaville, in western Nevada, was also in steady operation. It is reported that the mines at Bishop and at Sodaville have temporarily closed and that smaller amounts of ore are being purchased by the mill at Atolia. The tungsten boom that was inaugurated in the last half of 1915 and continued into 1916, had the effect of opening up a large number of scheelite deposits and prospects. A number of the prospectors and operators made money while the boom lasted and a large amount of money was invested in the building of new mills and developing new territory. Irrespective of the gains or losses resulting from these investments and operations, a great benefit has been brought about by the corroboration of the opinion of old-time prospectors on the desert that there was enough undeveloped scheelite to supply almost any demand for tungsten ore.

Happy Camp District, situated in the far northwestern corner of Siskiyou County, is having a deserved boom in copper mining. The lack of transportation has prevented investors from undertaking development, and the prospect of railroad construction is still remote. But the transportation problem has been partially solved by the installation of freight and passenger motor trucks, running from Happy Camp to Yreka and Hornbrook. Also regular daily mail stages and an extra stage for parcel post and express, and animal-drawn freight wagons have also been put on the road. These improvements in transportation have had a stimulating effect upon the owners of both copper and gold properties and prospects. The Grey Eagle company, which recently attracted the attention of Eastern investors, has done a good deal of development and has purchased the Wright ranch, on Indian Creek, is building a road into Luther Gulch and constructing boarding and bunk houses for a large number of miners. The company is also operating the Howard-Davis copper mine on Clear Creek. The Crompton-Maddox company has disclosed good ore at 50 ft. and is developing. The Copper Mountain, the Bourse and the Bon Ton are preparing for active development. The Mohawk has been bonded to M. A. Delano, of Grants Pass, Ore. The Bradley-Stork company, operating a gold property on Independence Creek, is building a road from Klamath River to the mine, a distance of 14 mi. There are approximately 50 single claims being worked and there is an early-day activity prevalent. Altogether Happy Camp is in a way to attract the attention of wideawake investors.

Amador County Labor Strike Ended after the union learned of the determination of the mine owners to resume operation. Votes were cast at two meetings of the union, one at Jackson and the other at Sutter Creek. A majority of 17 in a total vote of 137 were in favor of returning to work. This total represents approximately one-half the striking element of the union. Western Federation officials sent from Denver advised calling off the strike, on the ground that it was not called "in accordance with the constitution of the Western Federation." A full complement of men cannot be obtained at present, but enough have shown willingness to return to prove that 1,500 men cannot be forever dominated by a handful of their fellows. It required six weeks of idleness and a loss of more than $150,000 in wages to put courage into the men not directly engaged in the strike. Possibly the report that strikebreakers would be brought in unless the former employees got busy had some effect. The almost absolute certainty that the courts would make permanent the injunction against interferences of strikers probably gave them courage. At any rate more than 25% of the full complement of men expressed by petition or otherwise their desire to be taken back under the conditions and wages that obtained prior to the strike. There is no doubt that as many more would have been included but for the fact that nearly one-half of the idle miners in the county left the districts immediately after the strike was called. It is expected that a large percentage of these men will return and that within a few months or even weeks, the mines will all be working full handed. The union has declared the strike off; there was nothing else to do; and now the officials of the Western Federation of Miners are reported to be saying that the strike was ill-advised. That was admitted by the secretary of the union when the strike was demanded by a majority of the 250 members of the union who were present at the strike meeting. The wonder of the whole situation is that so large a number of American citizens who have homes in the county, families to support and children to educate, should permit themselves to be frightened away from their work or persuaded to make unfair demands upon their employers. And the greater wonder is that this condition should arise when it was commonly reported that the voluntary raise in wages of last April was to have been repeated next April, possibly in January. The continued existence of a labor union which is controlled and dominated in its local affiliations by men who are not, and probably will never become, American citizens, is extremely doubtful.

BUTTE—Nov. 9

The Growth of Butte is a subject that attracts the attention not only of Butte's own citizens but of many outsiders. The payrolls of the Butte mines for October will be the largest in the history of the camp and the total will pass the $4,000,000 mark. Probably few communities of similar size can offer such a showing. Anaconda, Butte & Superior, North Butte and the Clark interests will pay to the men in the mines $2,340,000; another half million is paid by the Anaconda company to its smeltermen; adding to this the payrolls of other mining companies and those of the industries, directly or indirectly connected with mining, the total will reach the startling sum mentioned. Butte with its adjacent suburbs now has a population estimated at 100,000, which is growing by leaps and bounds and much faster than accommodations can be provided for for the newcomers. Though probably more than a thousand new buildings have been erected during the year, and numberless others are in course of construction, there is not a vacant house or room in the city at present. The hotels and rooming houses are crowded beyond their capacity. Rents are at top notch and continue soaring to unheard-of figures. Increased store rents necessitate increased prices for goods of every description, so that average living expenses have increased nearly 50% within the year. As a result, those who do not directly participate in the startling prosperity of the camp are hard pushed in their endeavor to make both ends meet. With the development of the eastern section of the Butte district and the promising results derived from it added to the already highly developed and exploited zinc resources of the camp, and the opening of new and large orebodies in the older mines on Anaconda hill, Butte is experiencing one of those old-fashioned booms, based, however, on the discovery of tangible natural resources, the existence or value of which not so very long ago was not thoroughly appreciated. Seemingly, the camp has entered a new era of prosperity and expansion, the magnitude of which it would be hard to predict.

DENVER—Nov. 9

Downtown Mines Co. at Leadville has begun regular shipments of ore. This project has been considerably delayed in being brought into production by the wholly unexpected tapping of a strong water course after the mines had been successfully unwatered. As yet, the only shipments are of high-grade manganese ore carrying a small quantity of silver, but shipments of zinc ore are counted upon to constitute the chief production when the property gets fully under way.

Revision of the Mining Law was urged at a meeting of the mining bureau of the Denver Civic Association. R. A. Parker, chairman of the mining bureau, stated that the present Federal laws had resulted in controversy, litigation and expense together with the retardation of mining development during long periods of litigation. He said that the situation had become so complicated that a thorough and intelligent investigation is an essential preliminary to the modification of the mining laws. Mr. Parker also declared that the public domain in the 11 states situated west of Kansas comprises 471,000,000 acres—13,000,000 acres in Colorado—and that the policy of the Federal Government concerning the disposal and utilization of this enormous area was of vital concern to Colorado and the other 10 states. Bulkeley Wells will head Colorado delegation to present matter before American Mining Congress.

SALT LAKE CITY—Nov. 10

Prosperity in Mining as well as in other industries in this section is reflected by Salt Lake bank clearings. For October these aggregated $55,165,284, an increase of $10,354,828 over the clearings for September, and an increase of $16,048,831 over last January.

Dugway District is More Active as a result of the beginning of work on the railroad into the Deep Creek section, adjoining Dugway on the west and separated from it by the Fish Springs Range and intervening valleys. Recently the Bullion Hill property in the Dugway district made a 33-ton shipment of high-grade lead ore, carrying also copper and silver; shipment averaged 48% lead, 9 oz. silver and 1.9% copper. The shipments are made by auto truck over a 51-mi. road to Faust station on the Salt Lake route. The Bullion Hill property is owned by J. P. Nelson, A. K. Tiernan and H. H. Green, of Salt Lake. The Laurel mine, adjoining the Bullion Hill and Golconda claims in the southern end of the district, has also made a recent shipment of high-grade lead ore; the ore from this property is mainly galena but carries some rarer minerals, linarite and caledonite, basic sulphates of lead and copper. Another developing mine in the Dugway district is the Piedmont, also owned by Salt Lake men. In the Deep Creek section, the Western Utah Copper Co. is preparing its mine for shipments on completion of the railroad. On the latter four gangs are at work, the grading contract having been let to the Utah Construction Co. The railroad is expected to be operating early next year.

Ohio Copper Stockholders received the first definite details of proposed re-organization plans from the North American Liquidation Co. on Nov. 9. Some details were announced last week. A new company is proposed with 2,500,000 shares, par value $1. Underwriters to take 1,500,000 shares at par; 850,000 shares to be placed in the treasury for the purchase of the Mascotte tunnel, railroad, etc.; 150,000 shares to be retained by the company for reorganization purposes. The underwriters syndicate offers, through the shareholders' committee, to the old stockholders (1,350,000 shares of Ohio issued) who deposit their stock with the New York Trust Co. the right to subscribe for 1,350,000 shares at $1 a share, each depositing shareholder having the right to subscribe and pay for the same number of shares as that deposited by him. If all old stockholders subscribe they would own the property free of all mortgage or other indebtedness and have nearly $200,000 working funds in the treasury. The underwriting syndicate will be obliged to provide and are stated to have ready on the committee's call the full amount needed to redeem the property at whatever figure may be fixed by the court. It is conceded by all that the property is at present fairly worth much more than its obligations. By the decision of the court the committee is privileged to pay into court the amount it finds due less whatever sums have been realized from the property by the trustees in bankruptcy, receivers and purchaser at the foreclosure sale. It is estimated that the amount required to acquire all assets of the company will be $1,100,000. The amount of bonds and accrued interest is $1,500,000, and net credits are $400,000. All shareholders shall be privileged to participate in the reorganization.

MORENCI, ARIZ.—Nov. 10

Strike at Arizona Copper Co. followed discharge of man for insisting on taking a longer siesta while on shift than the agreement calls for. Result is that all employees are out. When night shift of Nov. 4 went to work at the Clay mine and found that Don Juan, or José, as the case may be, actually would not receive any pay for the two weeks he was laid off for sleeping on the job, they were astounded. It was too much. They hoisted a red handkerchief on a candle stick, fell in and marched right back again. All the company's other miners came out in sympathy, and as a consequence the A. C. workings are silent. Of course, the case had been gone over thoroughly by the proper grievance committee, but the decision was against Juan, or José, therefore the committee had been illegitimately influenced. And the "Grand Covenant" lost its binding power, if it ever had any. But the strike sentiment is not unanimous. They are quarelling among themselves. The Americans, Spaniards and Italians want to work, but the Mexicans won't stand for it. And the Mexicans are in the majority. So the "whites" are holding indignation meetings and

such like, and for a time tried to raise the fuss to the dignity of a race war. The first flush of excitement and election now being over, however, the matter is easily recognized as a row within the ranks. The attitude of the company seems to be to keep hands off until the brethren come to some understanding among themselves as to what they want to do. Notwithstanding a great deal of talk and some apprehension to the contrary, the strike has not spread to any of the other companies operating in the district, and it looks at this time as if the trouble would be confined to its present limits.

OATMAN, ARIZ.—Nov. 8

Oatman Bureau of Mines has been organized to keep Oatman before the public as the livest gold-mining camp in the country. A publicity fund of $1,500 has already been subscribed and the following general executive committee named by President W. P. Geary: Judge P. D. Overfield, vice-chairman; A. C. Eisen, secretary and treasurer; J. A. Small, cashier of the Bank of Oatman; W. F. Gray, of the Times Mining Co.; T. E. Fisher, of the Fisher Building; Frank E. Strong, of the Red Lion, Empire and Aurora Mining Companies; Sam Bayles, leading merchant, and E. H. McPherson, editor of the "News." While publicity is the object aimed at, the bureau is determined that nothing but genuine publicity, without any "kick back," shall be secured. Therefore, great pains will be taken to verify and authenticate every item of news or every bit of information going out with the stamp of the Oatman Bureau of Mines upon it. "If the Oatman Bureau of Mines sends it out, it's so," has been suggested as a sort of slogan, and the motto of the bureau is to be "Everybody Helps." With this motto put into practice and the truth adhered to in its reports, the Oatman Bureau of Mines should succeed in its laudable effort of securing for Oatman the attention it deserves.

SPOKANE—Nov. 9

A Mineral Exhibit will be established by the Coeur d'Alene Mine Owners' Association in the new quarters of the Northwestern Mining Men's Association in the Spokane Hotel Building. The latter association has taken a long-term lease on a ground-floor apartment, adjoining the Silver Grill and connected with it, and is fitting it up as a permanent home for the organization, where open house will be maintained for visiting mining men. Several thousand dollars will be expended renovating the quarters and furnishing them, and the formal opening will take place the latter part of November on the return of the Spokane delegates from the American Mining Congress in Chicago. The purpose of the Northwestern Mining Men's Association, which is a reorganization of the Spokane Mining Men's Club, is to bring into closer relationship the mining men of the different districts in the surrounding territory and to endeavor to secure legislation, both state and national, beneficial to the mining industry. Secretary Bailey states that the membership includes all the prominent mine managers and owners, and in addition bankers, business and professional men—a combination of interests that assures representative influence in any movement the association may inaugurate.

WASHINGTON, D. C.—Nov. 11

Extension of Forfeiture Decree for idle Mexican mines was announced from Atlantic City on Nov. 13. Luis Cabrera, chairman of the Mexican representation, advised the American members of the Mexican-American Joint Commission that a further extension of 60 days, or until Jan. 14, had been given owners of mines in Mexico to reopen their properties. Under the terms of a decree issued several weeks ago, it was provided that such mines as were not being operated by Nov. 14 would be forfeited to the Mexican government.

Dedication of the $500,000 Building of the U. S. Bureau of Mines at Pittsburgh will take place during the week of Sept. 3, 1917, and technical and scientific societies of the country have been asked by Van. H. Manning, director of the Bureau of Mines, to hold their annual meetings at Pittsburgh at that time. The Pittsburgh branch of the Bureau of Mines is situated near the Carnegie Institute of Technology and the University of Pittsburgh. These institutions will coöperate to make the week a memorable one in the history of scientific gatherings in America. The additional benefits accruing to members of scientific societies, as a result of joint meetings at San Francisco, last year, have been the basis of much favorable comment since then. With this idea in mind Mr. Manning is hopeful that his proposal will be received with favor by many of the national technical organizations.

HOUGHTON, MICH.—Nov. 11

Output of Lake Superior District for the present year has been estimated at between 260,000,000 and 270,000,000 lb. While this is much in excess of previous productions, and considerably larger than last year's, it is locally regarded as conservative.

Mayflower-Old Colony Merger will probably be consummated shortly. There will soon be meetings of the stockholders of the Mayflower Mining Co. and of the Old Colony Copper Co. for the purpose of voting upon the merger. A new corporation with 200,000 shares is proposed. The shares in the old companies will be exchanged share for share in the new company, each company having 100,000 shares outstanding. Precedent to the proposed merger, the Old Colony treasury assets will be brought up to the amount of the Mayflower, so as to join the properties on an equal basis. This will involve an assessment on Old Colony. Officers and directors of the new company will be made up from those of the present companies. The sinking of a shaft is to be started immediately.

TORONTO—Nov. 9

The Short-Lived Calgary Oil Boom, by which so many investors were victimized, is recalled by an exemplary sentence pronounced by the district court at Calgary on George Edward Buck, a promoter found guilty of publishing a false statement regarding the well of the Black Diamond Oil Fields, Ltd. He was given a term of four years in the provincial penetentiary.

A Ruling on Excess-Profits Tax has been made by the Canadian Finance Department to the effect that all contributions by business firms and companies to the Red Cross and National Patriotic funds are to be considered as an expense against profits in calculating the amount of profits liable to taxation under the excess-profits law. As many mining and manufacturing companies have subscribed liberally to these funds this ruling will in such cases considerably reduce the amount to be collected.

The War Tax as applied to precious-metal mines appears to have been definitely settled, the basis being as follows: Capital is taken as five times the profits. Ten per cent. is allowed for depreciation and 7% for interest, and after deducting these two items from the net profits, 25% of the balance is taken by the Government. This is a moderate tax and imposes no hardship on the mines. For the last year the Dome tax was $27,500 and the Nipissing and Hollinger taxes about $70,000 each. Mines like the Porcupine Crown making a profit of $300,000 will pay only $11,500.

The Mining News

ARIZONA

Cochise County

SHATTUCK-ARIZONA (Bisbee)—October production was: Copper, 1,633,671 lb.; lead, 335,008 lb.; silver, 35,995 oz.; gold, 361 oz. Copper output for 10 months was 15,206,701 lb.

Gila County

INSPIRATION (Miami)—October copper production 11,300,000 lb. or 550,000 lb. less than in September.

Mohave County

NEW OATMAN COMPANIES recently passed upon by Arizona Corporation Commission are: Condor Mining Co., Big Otto Mining Co. and Summit Lode Mining Co.

GOLD DUST (Oatman)—Has started its mill; equipped with special machinery.

NELLIE (Oatman)—Drifting on orebody on the 350-ft. level. Sinking to the 500-ft. level will be started at once from the 350. D. F. Meiklejohn, superintendent.

Yavapai County

DUNDEE-ARIZONA (Jerome)—Shaft down to 450 ft. Will continue sinking at rate of 5 ft. per day.

CONSOLIDATED ARIZONA SMELTING (Humboldt)—Development has opened good orebodies both at the De Soto and at the Blue Bell mine, particularly at the latter; gravity-water concentration and flotation has given excellent recovery. Difficulties that arose in smelting of fine concentrates have now been satisfactorily overcome. Some custom ore being smelted. G. M. Colvocoresses, general manager.

Yuma County

MESSRS. LONG, McIVER AND RIDENOUR, of Oatman, are reported to be making preparations for the drilling of a copper property 8 mi. north of Parker.

CALIFORNIA

Amador County

CENTRAL EUREKA (Sutter Creek)—Assessment of 3c. per share levied to deepen 3,200-ft. shaft to 3,400 ft. Orebody on 3,100 and 3,200 levels will be explored.

PLYMOUTH CONSOLIDATED (Plymouth)—Mill is being supplied with about 350 tons of ore a day. New electric hoist working satisfactorily.

SOUTH KEYSTONE (Amador)—Machinery and other surface equipment being hauled to mine with motor truck; formerly used on the Amador Queen. J. H. Colpe, manager.

CONSOLIDATED AMADOR (Sutter Creek)—Bend in shaft near 800 level now straightened; water is below 850-ft. point and shaft retimbered. Bend resulted from following vein which was common practice in early-day mining. Total of 50 men employed, about one-half on surface in construction work.

Eldorado County

WHITE QUARTZ in Diamond Springs district is being examined with idea of using it for glazing enamelware by manufacturers at Point Richmond, in Contra Costa County. Shipment of 1,000 tons arranged by John Snow.

RISING HOPE (Placerville)—New Ingersoll-Rand compressor and Pelton waterwheel and drills recently instailed. George W. Engelhardt, manager.

OHIO (Placerville)—This gravel property near Smith Flat reported sold to Mr. Andrews, of Butte County, and Mr. Forsythe, of Alaska; formerly owned by Fairchild & Richard, of Placerville. Work will be started immediately.

PLACERVILLE GOLD MINING CO. (Placerville)—Sale of this property, embracing 23 claims and what is known as the Pacific shaft, situated in town, reported to have been made by Alexander Baring and associates, of London, to R. Chester Turner and associates, owners of the Brunswick mine at Grass Valley. The mine was closed down on account of the war, at a time when new development was in progress and after 40 years' continuous operation. Unwatering the shaft will begin immediately. Company's Sierra water system may be sold to Western States Gas and Electric Co.

Nevada County

HOOKWORM is believed by the State Bureau of Communicable Diseases to be prevalent among miners in the county; agents of the bureau are to investigate.

EL ORO (Lake City)—Unusual flow of water necessitates installation of additional pump.

INDIANA DREDGING CO. (Grass Valley)—Prospecting in Greenhorn Valley. Camp established near Missouri gulch.

GIRDETZ (Grass Valley)—Dragline scraper used by this lease to make opencut on Greenhorn Creek, in Arkansas cañon. Lease covers 3 mi. of placers extending from placer grounds of You Bet.

NORTH STAR (Grass Valley)—Thirty stamps dropping in Champion mill. Aërial tramway being installed to connect mill with Providence shaft, through which Champion ore is hoisted, and underground connection being made between Champion and Providence. Reported that 4-ft. ledge has been disclosed on 2,700 level.

DELHI (Nevada City)—Unwatering below fourth level; about 130 ft. more depth to be unwatered, using air-lift from fifth to fourth level and Worthington pump on the fourth. Expect to uncover bottom in about 10 days for development of 6-ft. vein in bottom level. Mine equipped with 20-stamp mill driven by water power. Water brought from branch of Yuba River near portal of tunnel. Tramway from top of hill to the river about 700 ft. Two Pelton water wheels in use.

San Bernardino County

AMERICAN TRONA CORPORATION (Trona)—Directors' report, issued in lieu of regular annual report, states: "The concentrating plant at Trona is now operating. The most difficult and expensive construction at the refinery at San Pedro is completed, although it will probably not be in operation before Mar. 1, 1917. The engineer considers that the concentrating plant at Trona, with additional vats, will probably treat between 500,000 and 600,000 gal. per day. About 120 tons of concentrated salts have been produced to date (October), and from now on the corporation expects to produce a minimum of 50 tons per day, which should gradually be increased to over 200 tons per day. With minor additions there should be no difficulty in producing from the refinery when finished at least 100 tons per day of high-grade potassium chloride and 50 tons per day of borax. A contract has been closed for 3,500 to 4,000 tons of Trona salts to be shipped by the

end of this year at a price that should give substantial profits."

Sierra County

WIDE AWAKE (Downieville)—Gravel, recently found, prospects well. Development will be continued all winter under option to Thomas Wilson.

PRIMROSE (Sierra City) — Eight contiguous claims bonded to M. D. Cogley and W. R. Brooks. Development will be prosecuted throughout winter.

ROCK CREEK (Downieville)—Telephone line completed to mine, winter supplies laid in and outside preparations for winter progressing. Three shifts driving main tunnel ahead in bedrock. Gravel prospecting well. W. F. Copeland in charge.

Tuolumne County

RED JACKET (Groveland)—Mill equipped with electric power and power drills installed. Some good ore developed. Property in Big Oak Flat district.

DUTCH-SWEENEY (Jamestown)—Shaft now below 1,900-ft. point. From Nov. 1, 1915, to Oct. 22, 1916, development has totaled 4,867 ft. Employing 125 men; equipment modern; electric power. W. J. Loring, manager.

HARVARD (Jamestown)—Only 67 men out of 130 are retained, making what is reported to be a final cleanup before closing down. If this is the purpose, no explicit information is available as to the cause. Mine has been in constant operation for 10 years and is said to have produced more than $3,000,000. Reported that the Harvard Mining Co. will undertake development of the Erin, a neighboring property.

COLORADO

Custer County

HERMAN (Silver Cliff)—Four cars mixed sulphide ore, containing gold, silver, lead and copper, shipped weekly to Salida smelting plant. Three shifts working in mine.

Gunnison County

COLORADO COPPER CO. (Iola)—Lease and bond taken on Anaconda mine by this Denver company. Steam hoist and boiler being installed and sinking will be resumed.

DOCTOR (Almont)—Steady production high-grade zinc carbonate ore being made; 12 teams hauling to Almont. Reported strike of lead ore made recently. Mine worked many years ago for lead only.

Hinsdale County

COLORADO-UTAH MINES OPERATING CO. (Lake City)—Fine grinding machinery will be installed in milling plant. Old stope filling and dumps to be treated.

Lake County

PROGRESSIVE (Leadville)—Mine adjoining Harvard on North Fryer Hill being reopened by Warren F. Page. Work of repairing shaft and 280-ft. level under way.

Park County

BLACK CLOUD (Alma)—Lessees on this property, near London mine, have opened shoot of gold-silver-lead ore.

Routt County

KRAMER (Oak Creek)—Sinking new two-compartment shaft to cut coal beds, prospected by diamond drilling, lower than one now being worked.

Saguache County

ST. LOUIS (Bonanza)—Shaft recently sunk 100 ft.; crosscutting to vein now under way.

HANOVER (Bonanza)—Reopening old tunnel. Some good grade lead-silver ore being stoped. Mine south of upper Rawley workings.

VILLA GROVE ONYX CO. (Villagrove)—Deposit of Mexican onyx being opened. Thirty-six varieties found in these quarries, colors ranging from yellow and buff through reds and maroon to black.

San Miguel County

IMES (Sawpit)—Shoot good-grade ore opened in shaft at depth of 75 ft. Shaft sinking will be continued.

TOMBOY (Telluride)—Mill ran 29 days in October crushing 12,000 tons ore yielding $46,200 in bullion and $49,000 in concentrates; expenses $66,300; operating profit $28,900.

Summit County

MILO (Kokomo)—Being reopened by local men.

ORO LEASING CO. (Breckenridge)—Shaft down 180 ft.; crosscutting to Oro vein.

COLONEL SELLERS (Kokomo)—Car shortage has materially reduced production recently.

RILLA (Breckenridge)—West heading on Witch Hazel vein advanced 40 ft. Shoot of milling-grade ore opened. Work being done by contract.

WILSON (Kokomo)—This mill running steadily on ore from mine and on custom ore. Of latter, large tonnage received.

MAYFLOWER AND SNOWFLAKE (Kokomo)—Both properties worked by Charles Walker. Two cars ore per week shipped.

TONOPAH PLACERS CO. (Breckenridge)—Crosscutting from old Miller shaft on opposite side of gulch from Wellington mine under way in effort to find zinc-bearing vein cut in dredging.

IDAHO

Blaine County

SILVER LEAD MINING CO. (Hailey)—Property adjoining Nay Aug mine has been bonded to Darwin Utter and associates including Raymond Guyer, Peyton Block, Spokane, Wash. Development will probably be undertaken in spring.

NAY AUG (Hailey)—This old mine optioned by Raymond Guyer and associates, of Spokane, and will probably be turned over for development to the Idaho Exploration Co. About 4,000 tons of zinc ore left by former operators is immediately available but deeper horizons will be investigated and mill installed. No work will be done until spring.

Shoshone County

HECLA (Burke)—Completing new sorting plant at mine. Preparing for stoping of East vein.

MISSOULA COPPER (Mullan)—This mine, containing some low-grade copper ore, may be reopened to take advantage of the present market. C. E. Mallette interested. Assessment may be levied.

MICHIGAN

A SILVER EXPLORATION by a party of Wisconsin and Michigan men is in progress in Ontonagon County. Several drills are now at work. Some silver was found in the district now being explored a number of years ago, but at that time not enough was disclosed to warrant opening a mine.

Copper

LAKE (Ontonagon)—Driving crosscut from shaft on the Knowlton lode on fourth and sixth levels to the Butler lode.

WOLVERINE (Kearsarge)—Shipped 27,000 tons of rock in October, assuring a production of approximately 450,000 lb. of copper.

TAMARACK (Calumet) — North Tamarack branch is showing better rock and shipments are increasing. Last month 30,000 tons went to the mills from this property.

INDIANA (Rockland) — Shaft down 85 ft. on the Butler lode. Crosscut will be driven both ways to ascertain width of lode and explore other lodes in vicinity—the Knowlton and Evergreen.

ALLOUEZ (Allouez)—Production continues to increase and November will break October's record. Instead of 10,000,000 lb. for the year Allouez will possibly turn out 13,000,000 lb.

MOHAWK (Mohawk)—Increased monthly shipments to 63,000 tons, so copper output ought to reach 1,120,000 lb. Improvements contemplated in handling waste sand at mills. Turbine to be installed soon.

KEWEENAW (Mandan)—Company still unable to work its mill all of day shift for want of trammers, having only one-half the number necessary. Up to Nov. 5, about 1,000 tons had been milled. No results will be announced until a larger amount of rock has been stamped.

HOUGHTON (Houghton)—Good ore in present workings on sixth level. At the bottom, 12th level, 160 ft. of good ground is showing, but it is difficult to maintain operations as rock has to be hoisted to the sixth level, trammed 250 ft. and then hoisted to surface.

AHMEEK (Ahmeek)—Conglomerate formation recently opened in long drift shows width of 6 ft. Drifting continues in good-looking rock carrying considerable mass and small barrel. Rock tonnage in October, 117,000 with copper output probable double that of early months of this year.

Iron

LAKE SUPERIOR SHIPMENTS of iron ore for October amounted to 9,116,196 tons, making a total of 57,932,846 tons up to Nov. 1. The year's shipments by water will reach 64,000,000 tons. The best previous record for a single year was in 1913, when 49,000,000 tons were moved. It is estimated that 75,000,000 tons will be required of the Lake Superior district in 1917, and preparations are already under way for moving this large tonnage. The railroads are ordering new cars and other equipment and new boats are under construction. The underground mines will stock all of the ore they can get out this winter. Some ore will be left in stock at the close of navigation at some of the mines. Several of the properties on the Menominee range, at Crystal Falls and Iron River, were unable to move everything this season, but there was much ore in stock at those two places. Some had been in the piles for years.

MANSFIELD (Crystal Falls)—J. M. Longyear is doing exploratory work here. Mine has been idle three years; some ore still in lower levels. It is believed that other deposits exist on the property. Mr. Longyear has an interest in the fee. Diamond drilling is to be done.

MINNESOTA

Mesabi Range

IN THE BIWABIK DISTRICT every underground mine is being worked to capacity. Stockpiles have been shipped and ore is now being stocked for next year's delivery. The Biwabik Mining Co. has made another big find of ore; this will be stripped; part of the deposit lies under the dump of the Biwabik mine. Some diamond drilling is being carried on in the district, but not so many drills are at work as when the Oliver Iron Mining Co. was exploring a few years ago.

YORK (Nashwauk)—Coates & Tweed, operators, are to open this property. Dragline excavators have recently been put to work. About 700,000 cu.yd. of overburden will be stripped this winter. It is expected that ore will be shipped next year. An ore-washing plant will be supplied by the Allis-Chalmers Manufacturing Co. Later mine will be worked from underground.

U. S. STEEL CORPORATION (Duluth)—Checks and orders aggregating $2,067,501 have been paid by the corporation into treasury of St. Louis County. Represents last half of current real-estate taxes on its holdings in the county through the Oliver Iron Mining Co., the Minnesota Steel Co. and other subsidiaries. In addition to the above the corporation also pays heavy taxes in Itasca County, where are several of its mines. Corporation is largest taxpayer in Minnesota.

MONTANA

Beaverhead County

BANNACK GOLD (Bannack)—New 200-ton mill is completed. Management states that it has enough ore of average value of $11 per ton to keep mill busy for five years.

Silver Bow County

EAST BUTTE (Butte)—October copper production 1,650,160 lb.; silver, 51,022 oz.; copper output slightly lower and silver higher than in recent months.

NORTH BUTTE (Butte)—Granite Mountain shaft now down 700 ft. below 3,000 level. Stations being cut on 3,200, 3,400 and 3,600 levels. Development of properties in eastern section of Butte district is continuing. Aim is to increase output to 2,500,000 lb. copper per month.

BUTTE & ZENITH CITY (Butte)—Showing in vein encountered in south crosscut is improving steadily. Vein is 10 ft. wide, over 2 ft. of which runs high in copper. Another vein showing copper encountered in north crosscut. The big Economic vein which is counted upon to furnish the bulk of the ore is expected to be reached by the scuth crosscut after another 200 ft. of driving. Mine is about 6 mi. west of Butte.

ANACONDA (Butte)—October copper output of 31,500,000 lb was an increase of 2,100,000 lb. over September production and makes total 10 months of 282,400,000 lb. Company's activity in the Coeur d'Alene district in exploiting the Douglas mine and in making contracts in that district for purchase of 25,000 tons of zinc ore from other mines up to Jan. 1 is indicative of company's plans to extend its zinc industry into fields outside of Butte.

NEVADA

Esmeralda County

SANDSTORM-KENDALL (Goldfield)—On 350-ft. level, south drift now out beneath old lease workings and raise being driven to connect.

GREAT BEND (Goldfield)—A north crosscut from east drift, 300-ft. level, encountered ore of good grade beneath old lease workings. Regular shipments being made to sampler average $25 to $35 per ton.

GOLDFIELD CONSOLIDATED (Goldfield)—Final report for September shows 25,800 tons treated; net realization, $16,072.05; total operating costs, $5 35; net operating costs, $5.83 per ton. There was 2,255 ft. of development done at $6.83 per ft. About 200 tons per day sent to mill from old Combination tailings dump.

Lincoln County

PRINCE CONSOLIDATED (Pioche)—Mine continues to ship about 400 tons per day to smeltery. Stated new mill at Bullionville working successfully and tailings from old dumps expected to yield profit of about $4 per ton.

Mineral County

NEVADA NEW MINES (Rawhide)—Stated entire face of winze in mill ore of excellent grade with occasional specimens of ruby silver at depth of 50 ft. below 600-ft. level.

Nye County

TONOPAH ORE PRODUCTION for week ended Nov. 4 was 10,176 tons, valued at $199,108, compared with 9,959 tons for week previous. Producers were: Tonopah Belmont, 3,088 tons; Tonopah Mining, 2,400; Tonopah Extension, 2,380; Jim Butler, 1,050; West End, 852; Rescue-Eula, 852; Halifax, 153; McNamara, 54 tons.

ROUND MOUNTAIN MINING (Round Mountain)—With advent of low water at placers, about 15 teams and scrapers are being used to convey some of the richer material to the sluices.

Storey County

ANDES (Gold Hill)—Saved 60 cars of ore from 350 level.

JACKET (Gold Hill)—Operated 10 mills and two Deister tables four days; 15 mills and three

Deister tables, two days; cyanide plant, full week; 512 tons dump rock put in mill bins.

COMSTOCK PUMPING ASSOCIATION (Virginia)—Changed over sinking pumps in the Mexican-Ophir winze; now operating as station pumps. New vertical sinking pump installed to pump out 2,900 level.

UNION (Virginia)—Extraction from 2,500 level included 47 tons averaging $28.80. No marked change in prospecting and development on five levels. Favorable formation continues in the face of exploration drifts in Union, Sierra Nevada, Mexican, Ophir, Con. Virginia.

NEW YORK

St. Lawrence County

NORTHERN ORE CO. (Edwards)—Sinking 1,000-ft. double-compartment vertical shaft to reach territory explored last year by diamond drills; work is proceeding from surface as well as from the 400 level of No. 1 slope. Mill is treating from 150 to 200 tons daily supplied from two lenses developed by No. 1 slope. The No. 2 or White mine is now connected with No. 1 slope by drift on the 400 level and extraction is proceeding from both mines. Justice Grugan, manager.

UTAH

Beaver County

BEAVER LAKE METALS (Milford)—First car ore—copper-silver—shipped.

COPPER RANCH (Milford)—Three cars weekly being shipped from mine, 12 mi. northwest of Milford.

RED WARRIOR (Milford)—Property in Star district, adjoining Moscow, to resume operations at once. Controlled by Michigan men. Angus Buchanan, general manager.

HORN SILVER MINING, MILLING AND WATER CO. (Frisco)—Reorganized company expects to build plant to handle tailings dumps containing 50,000 to 60,000 tons; also to supply equipment to handle ores from surrounding territory.

Box Elder County

ROZELLE OIL (Brigham City)—Company drilling on edge of Great Salt Lake, near Rozelle, on west side of Promontory, struck some thick heavy oil resembling liquid elaterite or gilsonite. Wells down 150 and 165 ft. Ogden and Brigham City men interested.

Juab County

TINTIC PRODUCTION for four weeks was 823 cars by about 40 shippers. Value of weekly output estimated at $250,000.

RIDGE & VALLEY (Eureka)—Production for first 10 months of 1916 about 1,000 tons. Two full faces of lead ore on 1,700 level.

LEHI TINTIC (Eureka)—Tunnel being driven for Blossom vein in 2,200 ft. Daily progress of 4 to 5 ft. being made. Property in North Tintic.

SCRANTON (Eureka)—Lessees shipped 10 cars in October. Eight cars of zinc ore and two of lead. Lead cars averaged 17 to 18% and zinc 30 to 36%. Thirty men working.

GEMINI (Eureka)—October shipments amounted to 39 cars, or approximately 2,000 tons of ore. Shipments average between 500 and 700 tons weekly; in first 10 months, 421 cars or 21,000 tons of ore shipped.

SIOUX CONSOLIDATED (Eureka)—Winze from 600 level down 100 ft. No change in formation, but mineral showing sufficient to be encouraging. Duncan & Allen, contractors, have sunk shaft 60 ft. since Oct. 17. Three shifts working.

EUREKA BULLION (Eureka)—Company, which took over old Grutli claims in east Tintic, preparing to install new equipment—compressor, 60-hp. steam boiler, etc. Old hoist will probably be used. Main shaft down 220 ft. to be sunk farther. Property near the Tintic Standard.

TINTIC STANDARD (Eureka)—Work started on new three-compartment shaft 1,700 ft. northeast of present workings. Expected to reach orebody on 1,300 level in seven months. Blower installed on lower levels where lead-silver ore is being mined and developed. Ore brings from $1,400 to $1,500 a car.

CHIEF CONSOLIDATED (Eureka)—Report for nine months shows ore sales amounting to 62,006 tons, bringing $1,153,000. Ore averaged $31.38 per ton; sampling and freight, etc., amounted to $12.78; $18.60 net from smelter; total net, $474,247. Development amounted to 17,950 ft., largely from 900 to 1,800 level. Work started on new claims known as Piñon Peak group in eastern part of district; shaft sunk and drifting done. Eureka City Mining Co. dissolved. Option on Scotia mine in West Tintic surrendered and work abandoned. Numerous additional mining claims purchased; also majority of shares in adjoining Plutus. Ground to be worked from the Chief.

Piute County

MINERAL PRODUCTS CO. (Marysvale)—Several buildings, part of headhouse, trestle, etc., at alunite mine were burned Nov. 2. Hauling from mine to mill will be done by team until repairs can be made.

Salt Lake County

MICHIGAN-UTAH (Alta)—New orebody opened by Triangle Mining Co., lessees; exposed 8 by 9 ft. and ore in face of crosscut.

MONTANA-BINGHAM (Bingham)—Good progress being made in driving tunnel—face now in 4,250 ft.—in Bingham-Amalgamated ground. Expected to cut two veins.

UTAH APEX (Bingham)—Stockholders voted to reduce number of shares from 600,000, par value $5, to 125,000 shares, par value $25. At present there are 528,000 shares issued. Two dividends aggregating $195,000 have been paid this year.

CARDIFF (Salt Lake)—Larger production being made; between 100 and 150 tons daily being shipped. Ore hauled by teams to mouth of South Fork, thence by tractors to sampler at Murray. New tractors working well.

EMMA COPPER (Alta)—Shaft unwatered to second level below Bay City tunnel. Some repairs, etc., necessary before work of crosscutting for orebody will be undertaken. Materials, rail, supplies, etc., being hauled to property for winter.

ALTA CONSOLIDATED (Alta)—Robert A. Brown, formerly mine superintendent at Centennial-Eureka, in Tintic district, has been employed as superintendent to take charge of development, etc., during absence of A. O. Jacobson, general manager. Hoist installed to sink on bedded vein carrying copper, below tunnel level.

Summit County

NAILDRIVER (Park City)—Fisher lease working on vein 7 ft. wide in places. Sorting out high-grade for shipment.

COPPER APEX (Park City)—Excellent showing of ore in winze. Some ore accumulated awaiting shipment. Property recently inspected by C. P. Brooks.

AMERICAN FLAG (Park City)—Ore running well in silver and gold being mined on 1,000-ft. level from Easter vein. Porphyry dike cut on 700. Worked by Park City Mines, lessees.

SILVER KING CONSOLIDATED (Park City)—New 10,200-ft. tramway operating, and approximately 1,000 tons of ore carried from mine to mill and sampler. New 50-ton mill in operation. Thaynes cañon tunnel in 850 ft.

BROADWATER MILLS (Park City)—Recent tests and sampling of tailings on company's ground reported satisfactory. Force of men cleaning up preparatory to work of remodeling and making necessary changes in mill. Additional equipment to be added and capacity increased.

DALY MINING (Park City)—Planning erection 150-ton mill for completion early next summer on site of old Marsac mill. Will treat low-grade old-stope filling and dumps, also quantity zinc-lead sulphides in lower mine levels. Occasional ore shipments being made with satisfactory returns. Col. E. A. Wall, Salt Lake, president.

VIRGINIA

Spottsylvania County

VIRGINIA LEAD AND ZINC CORPORATION (Jones Store)—Good-grade lead and zinc ore being found in this property. Shaft down 250 ft. Has shipped 5,000 tons and has another 5,000 tons of shipping ore on stockpile. Much ore ing blocked out. W. Washabaugh, superintendent.

WASHINGTON

Ferry County

LONE PINE-SURPRISE MINING CO. (Republic)—This Spokane company has contracted with C. S. Cox and J. E. Henwood of Kellogg, Idaho, to sink a 500-ft. shaft on Last Chance claim. Hoist, five-drill compressor and 100-hp. boiler ordered. Last Chance orebody proven at 540-ft. level from workings of adjoining Insurgent mine.

WISCONSIN

Zinc-Lead District

UTT-THORNE (Platteville)—Subleased Harris mine and mill equipment at Mineral Point.

SPRING HILL (Linden)—A new 2-jig mill equipment has been completed on the Thomas Heathcock land.

STRAWBRIDGE (Platteville)—George Orput and Milwaukee interests negotiating for mill to equip this old producer south of Benton.

CANADA

British Columbia

BLUE BELLE (Kootenay Lake)—About 90 men working; mine being developed to fourth level.

ATHABASCA (Nelson)—A. E. Rand and partners are resuming operations on this old gold property.

ROCHER DE BOULE (Hazelton)—Lower tunnel now in over 1,500 ft. and rapid progress is being made.

UTICA (Kaslo)—Driving of 1,900-ft. crosscut tunnel at cost of $20,000 will be started at once to tap vein 350 ft. below present workings.

DOME MOUNTAIN (Telkwa)—Rich find gold and silver ore made by Chisholm Bros. & Young; several tons sacked for shipment running $400 to $600 per ton.

ECHO (Silverton)—Two feet of galena ore opened in lower tunnel; drifted on for 40 ft. Tunnel in 700 ft. Property adjoins Alpha claim of Standard mine.

SULLIVAN (East Kootenay)—For the third consecutive week this mine has been largest shipper in the Kootenays to the Trail smeltery, with 3,143 tons of lead-zinc ore to its credit.

Ontario

R. A. P. SYNDICATE (Boston Creek)—Work resumed after repairs to plant.

ANCHORITE (Porcupine)—Option to the Coniagas of Cobalt extended for six months.

KRIST (Porcupine)—To be merged with the South Thompson; will be opened by new company.

DAVIDSON (Porcupine)—Crosscut on 300-ft. level has cut orebody developed on upper levels.

ROSS (Porcupine)—Diamond drilling to a depth of 2,000 ft. has been undertaken on these claims.

McINTYRE (Schumacher)—During next year expects to be able to treat 600 tons a day of $10 ore.

SCHUMACHER (Schumacher)—Has opened new vein which for short length drifted on shows $30 ore.

PORCUPINE GOLD REEFS (Porcupine)—Leased to syndicate which will shortly begin development.

ASSOCIATED GOLDFIELDS (Larder Lake)—Station being cut at 300-ft. level and shaft will be sunk 200 ft.

MAIDENS-McDONALD (Porcupine)—La Rose Consolidated given extension of option; shaft will be put down to 300-ft. level.

INSPIRATION (Porcupine)—Diamond drilling to strike continuation of the Hollinger Consolidated vein system started at two points.

CHAMBERS FERLAND (Cobalt)—Cut apparent extension of famous No. 64 vein of Nipissing, but silver content was disappointing.

LA ROSE (Cobalt)—Getting satisfactory results on Kirkland Lake property under option. Shafts will be sunk and small plant will probably be installed.

ST. ANTHONY (Sturgeon Lake)—Power plant in good working order and $200,000 has been set aside for development during winter. H. H. Lavery, lately with Dome Mines in Porcupine, is in charge.

ADANAC (Cobalt)—On Nov. 4 cage accident caused death of Marion Sturgeon and another employee whose name was not ascertained, and serious injury of two other miners. Cable broke and cage fell 25 ft.

VIPOND (Schumacher)—This mine and the North Thompson have been examined with view to amalgamation. North Thompson ore will be treated in the Vipond mill to see if present mill is suitable for this class of ore.

MILLER LAKE-O'BRIEN (Gowganda)—Rich vein recently discovered has been drifted on for 120 ft. and a raise of 50 ft. put up. The ore carries 3,000 oz. per ton; average width of vein, 25 in. Shipment containing 53,000 oz. silver made.

MEXICO

SANTA GERTRUDIS (Pachuca, Hidalgo)—Milled in September, 18,993 tons; estimated profit about $21,000.

ESPERANZA (El Oro, Mex.)—September estimated operating profit $10,500. Repairing in stamp mill was to have been completed by November, when production was to be increased.

CANANEA CONSOLIDATED (Cananea)—October estimated production: Copper 6,030 000 lb.; silver 177,999 oz.; gold 915 oz. September copper output was 4,900,000 lb.

EL ORO MINING AND RY. (El Oro, Mex.)—Secretary's notice to stockholders states that in view of Carranza's decree of Sept. 16 declaring forfeited any properties failing to resume by Nov. 14, or suspending operations for an aggregate period of three months in one year thereafter, the directors instructed Manager A. F. Main to resume milling operations, "after having fortified themselves with influential advice." Cable information was received Oct. 20 stating that 70 of the 100 stamps were dropping.

TRINIDAD, B. W. I.

TRINIDAD CENTRAL OILFIELDS (Winchester House, E. C., London, Eng.)—During past year, drilling program restricted on account of shipping facilities; eight wells drilled, all producers. At Tabaquite, 1,000-ton steel storage and additional pumping machinery added. At Claxton Bay loading station on the Gulf of Paria a 4,000-ton steel storage tank has been erected. On account of inability to arrange for rail transport with government, company is building 18-mi. pipe line to connect with its submerged pipe line which extends about ½ mi. into the sea where sufficient depth is obtained for loading tank steamers.

CHILE

BRADEN (Rancagua)—September copper production was 2,970,000 lb. as against 2,616,000 lb. in August.

CHILE EXPLORATION (Chuquicamata)—September copper output, 4,038,000 lb.; August production, 3,020,000 lb.

CENTRAL CHILI (Panulcillo, Coquimbo)—Copper output for nine months of this year 2,005 long tons. Freight to New York on copper now about four times what it was prior to the war. Equipment at mine and smelting plant being improved.

The Market Report

Metal Markets

NEW YORK—Nov. 15, 1916

All of the metal markets were strong last week, and in copper, which is in an unprecedented position, there was a sharp advance. In tin also there was a sharp advance. Spelter advanced a little. Lead was stationary, but still strong.

Copper, Tin, Lead and Zinc

Copper—Again there were huge sales, the aggregate being apparently in the neighborhood of 125,000,000 lb., or about the same as in the previous week. The major business was for delivery in the second quarter of 1917. Producers are all but completely sold out for first-quarter delivery, and that position is as tight as November-December was a little while ago. As for November-December delivery at present, terms may be almost anything.

The market advanced sharply from day to day on insistent buying by domestic consumers, who had overstayed their market and were obliged to have copper, almost regardless of price, to fill contracts for goods already taken. A person needing copper called up a producer, got a price and 30 minutes to think about it. If action were not taken within that time, the opportunity was lost, other persons being desirous of getting the same copper. This illustrates how much of the business was done. The large producers endeavored to take care of their regular customers as best they could, but seldom were they able to furnish more than part of what was needed, and buyers had to seek elsewhere for the remainder. Prices were therefore at sixes and sevens. A buyer needing 3,000,000 lb. of copper and purchasing during the day might have to get it from three different quarters and at a different price in each. In most offices sales were made toward the close of the day at higher prices than at the opening.

November-December copper sold at 32½c., r.t., as early as Nov. 9. At the close of the week, it was still quoted at 32@33c., and we heard of transactions between those figures on Nov. 14. First-quarter delivery was 31c., r.t., up to Nov. 14. On Nov. 14 it was 31½c., and on Nov. 15, 32c. Second-quarter delivery, which constituted the major market, advanced from an average of about 29c. at the beginning of the week, to about 31c. at the close.

There was some business done in several quarters for delivery during the second half of 1917, but the largest producers did not enter into such contracts.

The buying of the week was almost wholly from domestic quarters. Inquiries from France were reported, but no transactions consummated.

Not all consumers were short of copper. There was reselling by some consumers, who either figured that they had overbought or thought they might take a chance later on.

There was gossip that the foreign governments were offering to sell nearby copper, previously bought, for which they had been unable to secure transportation. We could not verify this. However, there is no doubt that there is some unshipped supply of copper here that is owned abroad.

The Southern Pacific Ry. has put an embargo on copper shipments. This will check some supplies of crude copper from coming forward, but the refiners are believed to be amply provided with raw material.

The American minister to Norway cabled to the State Department, Nov. 10, that an agreemene has again been reached by the Norwegian and British Governments allowing the shipment to Norway from the United States of 3,000 tons of copper provided an equivalent amount of Norwegian copper pyrites is shipped to England.

Copper Sheets—The base price for copper sheets has advanced to 40c. Wire has also advanced, quotations now being 35@36c.

Tin—A very large business was done, especially on Monday and Tuesday when the turnover was exceptional. The supply of spot tin is very short. This condition led to a sharp advance. At the beginning, spot was 42⅞c., futures, 41½c. At the close, spot was 44⅞c., futures, 44c.

Lead—A large business was done at unchanged prices in this market, but in St. Louis there was a slightly easier tone. Canada continued to be a large buyer. There were sales to China. Inquiries were in the market from Japan and Russia, but consummation of that business was not reported.

Spelter—Business in common spelter was considerably more active. While there was some increased demand from domestic consumers, a good deal of the buying was done by speculators and by refiners. The major part of the business reported was for delivery during the first quarter of 1917, but there were some sales extending to the middle of that year. The price continued to advance. A moderate business in brass special was done and a fairly large business in high grade. At the close, high grade was quoted at 16@17c.; intermediate, 99¾% Zn, at 15@16c.; intermediate, 99 5% Zn, at 13@14c.; and brass special, at about 11½c.

Exports from Baltimore included 818,051 lb. in pieces and 615 tons in plates to Liverpool and London.

Zinc Sheets—The base price on zinc sheets has advanced. The quotations are now at $17 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

Antimony—Spot was quoted at 13@13½c. Some of the important producers are holding for higher prices. There was a sharp advance in the London market during the week, which was reflected in this market.

Quicksilver—The market was fairly steady at $80, the same price as last week.

Aluminum—There has been no noticeable slackening of demand for this metal. At the same time, there has been no definite change in price, quotations remaining at the same figures as last week, 64½@66c. per lb. for No. 1 ingots, New York.

Nickel—Price remains the same as last week, 45@50c. per lb. Electrolytic brings an additional 5c. per lb.

Gold, Silver and Platinum

NEW YORK—Nov. 15

Gold—The holdings of gold by the Bank of England against its notes shows a decrease of £357,990 as compared with previous week's returns, according to report from Samuel Montagu & Co., London, Oct. 26, 1916.

Silver has improved and is selling on higher basis the past week owing to the improvement in the China Exchanges. Shipments from San Francisco to the East which for a time were slack have been resumed. The undertone of the market in view of the probable demand continues good to steady.

Silver—Samuel Montagu & Co., London, under date of Oct. 26, report that: Supplies have been forthcoming with such steadiness, especially from America whence some 200,000 oz. arrived this week, that buyers have been somewhat shy, and the tendency of prices has been downward, until on Oct. 24, 32⅛ was reached for the third time this month. This quotation, the lowest since Aug. 31, has seemed to encourage more activity in the demand for coinage.

The Indian Bazaars have been idle in this market. China exchanges have remained remarkably steady, regardless of the fluctuations of silver. The stock in Shanghai on Oct. 21 consisted of about 23,500,000 oz. in sycee and 16.500.000 in dollars, as compared with about 24,000,000 oz. in sycee and 16,500,000 dollars on Oct. 14 last.

The totals in Shanghai for Oct. 21, are about half of those held on Jan. 7 last, when 50,500,000 oz. in sycee and 22,380,000 dollars were reported. The difference between the amounts held at the two periods is equal to about 31 500,000 oz.

The stock in Bombay consists of 4,000 bars, as compared with 3,200 bars last week.

During the week a shipment of 200,000 oz. was made from San Francsico to Bombay.

Platinum—Market steady; quoted at $95@100.

Palladium—Unchanged at $75 per oz.

Zinc and Lead Ore Markets

Platteville, Wis., Nov. 11—Quotations of the district are according to the following figures: Base price per 2,000-lb. ton for material assaying 60% zinc advanced to $85 for premium ore and to $80 for medium grade. For material assaying 80% lead the base price per 2,000-lb. ton is $80@82. The exhaustion of reserve stock and increased demand for zinc ore stimulated prices. Shipments for the week were 3,513 tons of zinc ore, 69 tons of lead ore, and 663 tons of sulphur ore. For the year to date the figures are 112,916 tons of zinc ore, 3,794 tons of lead ore, and 27,697 tons of sulphur ore. Shipped during the week to the separating plants, 2,753 tons of zinc ore.

Joplin, Mo., Nov. 11—Price quotations per 2 000 lb.: Blende, high, $91.50, 60% zinc, premium ore, $90; medium grades, $88@84; low, $80. Calamine, per ton 40% zinc, $50@40. Average selling price, all grades of zinc, $74.94 per ton.

Lead, high price, $88.30; base, $88@84; average selling price, all grades of lead, $85.70 per ton.

Shipments of the week: Blende, 7,948 tons, calamine, 482 tons, lead 1,143 tons. Value, all ores the week, $729,740; 45 weeks, $32,137,030.

Higher prices were begun on calamine Wednesday, with an advance of $5 per ton, and the heavy inquiry on Thursday ripened into an advance of $10 per ton for blende on Friday and the market closed active tonight. That the market was in no measure depressed over the political uncertainty was a surprise and was gratefully accepted.

Keen and intense interest prevails in the lead situation and further slight advances were made in prices. A light mid-week rain aided in permitting several mines to resume operations, even though but temporarily.

SILVER AND STERLING EXCHANGE

Nov.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Nov.	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
9	4.7569	71⅛	34⅛	13	4.7569	71⅛	34 3/16
10	4.7569	71⅛	34⅛	14	4.7563	71⅛	34 3/16
11	4.7569	71⅛	34 3/16	15	4.7563	71⅛	34 3/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Nov.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
9	28½ @29½	42⅞	7.00	6.87½ @6.92½	10½ @11
10	29 @30	43⅜	7.00	6.87½ @6.92½	10½ @11
11	29 @30	43½	7.00	6.87½ @6.92½	10½ @11
13	29½ @30½	43⅞	7.00	6.87½ @6.92½	10½ @11
14	30 @31	44¼	7.00	6.87½ @6.92½	10½ @11
15	30½ @31½	44⅛	7.00	6.87½ @6.92½	10½ @11

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" (r.t.) is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only St. Louis price is given, St. Louis being basing market. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Nov.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
9	124½	120½	148	184½	185½	30½	54¼
10	124½	120½	148	185	186¼	30½	55
11			148				
13	126½	121½	149	186½	187½	30½	55¾
14	128½	123½	152	188	189½	30½	56
15	129½	125	153	189½	191½	...	56

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. Copper quotations for electrolytic are subject to 3% discount. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜ cents.

Other Ores

Molybdenum Ore—Molybdenite is still in strong demand and offerings are readily taken at $1.75 per lb. of MoS_2. Ferromolybdenum was in demand at $3.65 per lb. for forward delivery.

Antimony Ore—Continues in demand. Offerings light. At present prices foreign ores are not coming in.

Tungsten Ore—We quote the market at $17 per unit.

Charles Hardy reports under date of Nov. 14 as follows: "The past week has seen the most active business for some time. Many hundred tons have changed hands and all the ore was bought for home consumption. In former weeks when hundreds of tons were sold, a large tonnage was for abroad. Pittsburgh stocks have practically been cleared of all high-grade ore and the New York stocks have been greatly reduced. The price paid has again been $17, and at this figure further contracts were made to cover part of 1917. The demand continues very active, Europe still negotiating for our ore, but as yet unwilling to pay our prices. In the meantime, however, Great Britain has contracted for the output of several South American properties to cover not only the duration of the war, but many years after peace has been declared. Japan has issued stricter orders which make exports from there very difficult, and this country's requirements will have to rely mainly upon home production and such ores from South America that are not yet contracted for by Europe. The prospects of a continuously steady market are good. Ferrotungsten is holding at $2.60 per lb."

Iron Trade Review

NEW YORK—Nov. 15

The pig-iron market continues to reflect the somewhat excited condition of the past two weeks, and there are further sharp advances in price. These advances, however, have not had much effect in reducing the volume of buying, which seems to continue strong. The action of steel prices is much the same, advances being registered with the possibility of further ones to come and the probability of full occupation for the mills throughout 1917. The election had very little effect upon the market, buying continuing and activity remaining about as usual. The action of the market during this election time is probably unprecedented.

PITTSBURGH—Nov. 14

Railroads are placing embargoes on some or all descriptions of freight and with car shortages increased and winter weather not yet experienced, but due, the appearances are very ominous and the balance of probability seems to be that iron and steel production will be curtailed in the next two months through lack of sufficient transportation facilities. According to all appearances the steel market is as strong as it possibly could be, with prices constantly advancing and buyers importuning mills to take more business than they are willing to accept, the mills having adopted a very reserved attitude in this respect. The Steel Corporation's unfilled tonnage increased during October by 492,676 tons, the largest increase since last April, but the excess of sales over shipments by the National Tube Co. and American Sheet and Tin Plate Co., the latter having opened its books for first-half on Oct. 12, accounted for more than the total increase showing that the other corporation subsidiaries booked materially less tonnage than they shipped.

Pig Iron—Advances in the past week are $2 in bessemer and basic, $1.50 in malleable and $1 in foundry iron. Only a few lots are sold at a price, the seller thereupon advancing quotations and getting the advanced price within a day or two. The leading merchant producer of bessemer iron, which has steadfastly been out of the market during this rise, and was accordingly suspected of being oversold, has now come into the market, apparently with plenty of iron, a fact of considerable interest to the trade. The last sale of basic is 7,000 tons for first-quarter at $25, but there are rumors of $27 having been done. While furnaces sold first-half deliveries of all grades freely last August, before the present advance started, they probably still have considerable iron to sell. In foundry iron the second-half market is now open, with a fair volume of business done. We quote: Bessemer, $30; basic, foundry and malleable, $25@26, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Steel—An inquiry for 60,000 tons of sheet bars has just appeared, for the 24-mill tin-plate plant to be completed about next March by the Bethlehem Steel interests at Sparrows Point, Md. It had been supposed that the plant would be supplied by one of Bethlehem's own mills. There is hardly any steel offered in either billet or sheet-bar form and the producers indeed would prefer not to have some of the long-term contracts now in force. We quote prices, largely nominal, at $50 for billets and $52 for sheet bars as minimum, with forging billets at $70@75 and rods at $60@65.

Following the lead of the National Tube Co., all manufacturers of wrought-iron and steel pipe are advancing prices about $2 per ton. The new lists reducing discounts one point are dated today. Steel line pipe is likewise advanced one point. New base for discount on standard steel pipe is 68% off list.

STOCK QUOTATIONS

N. Y. EXCH.†	Nov. 14
Alaska Gold M.	12
Alaska Juneau	7
Am.Sm.&Ref.,com.	116½
Am. Sm. & Ref., pf.	115
Am. Sm. Sec., pf. A	99½
Am. Sm. Sec., pf. B.	94
Am. Zinc	57⅛
Am. Zinc, pf.	82
Anaconda	100½
Batopilas Min.	1⅛
Bethlehem Steel	640
Bethlehem Steel, pf.	150
Butte & Superior	66
Chile Cop.	25½
Chino	67⅛
Colo.Fuel & Iron	54½
Crucible Steel	90
Dome Mines	24½
Federal M. & S.	18
Federal M. & S., pf.	44
Great Nor., ore ctf.	43½
Greene Cananea	51½
Homestake	130
Inspiration Con.	68⅛
International Nickel	50⅛
Kennecott	56
Lackawanna Steel	97½
Miami Copper	43⅛
Nat'l Lead, com.	67⅛
National Lead, pf.	112½
Nev. Consol.	28
Ontario Min.	6⅛
Quicksilver	2⅛
Quicksilver, pf.	3½
Ray Con.	34⅛
Republic I.&S.,com.	84
Republic I. & S. pf.	115½
Sloss-Sheffield	81
Tennessee Copper	23
U. S. Steel, com.	122⅛
U. S. Steel, pf.	121⅛
Utah Copper	119½
Va. Iron C. & C.	57½

N. Y. CURB†	Nov. 14
Buffalo Mines	1
Butte & N. Y.	2½
Butte C. & Z.	18⅛
Caledonia	.53
Can. Cop. Corpn.	2 1/16
Cashboy	.06
Cerro de Pasco	43½
Con. Ariz. Sm.	2⅛
Con. Coppermines	3
Con. Nev.-Utah	1/16
Crystal Cop.	.75
First Nat. Cop.	4½
Florence	.70
Goldfield Con.	.54
Goldfield Merger	.06
Granite	.40
Hecla Min.	8
Howe Sound	6½
Jerome Verde	1⅛
Joplin Ore & Spel.	.52
Kerr Lake	4½
Magma	.55
Majestic	.65
McKinley-Dar-Sa.	.62
Mother Lode	.37½
Nevada Hills	.21
N. Y. & Hond.	17½
Nipissing Mines	9
Oro	.03½
Ray Hercules	4½
Rochester Mines	.69
St. Joseph Lead	20½
Standard S. L.	1 1/16
Stewart	1/16
Success	.45
Tonopah	5½
Tonopah Ex.	5
Tribullion	⅛
United Zinc	4⅛
White Knob, pf.	2½
White Oaks	4½
Yukon Gold	2½

SAN FRAN.*	Nov. 14
Alta	.04
Andes	.09
Best & Belcher	.05
Bullion	.01
Caledonia	.26
Challenge Con.	‡.05
Confidence	.17
Cons. Imperial	.01
Con. Virginia	.08
Gould & Curry	.03
Hale & Norcross	.08
Jacket-Cr. Pt.	.04
Mexican	.09
Occidental	.65
Ophir	.20
Overman	.02
Savage	‡.10
Seg Belcher	.02
Sierra Nevada	.25
Union Con.	.54
Utah Con.	.02
Belmont	4.50
Jim Butler	.90
MacNamara	.08
Midway	.21
Mont.-Tonopah	.22
North Star	.15
Rescue Eula	.26
West End Con.	.75
Atlanta	.09
Booth	.09
C.O.D. Con.	.03
Comb. Frac.	.05
D'field B.B.	.05
D'field Daisy	.05
Jumbo Extension	.27
Round Mountain	.35
Sandstorm Kendall	.03
Silver Pick	.21
Central Eureka	‡.05
Argo	.06
Ariz. Central	.05
Big Jim	1.12½
Lazy Boy	.06
Nellie	.35
Tom Reed	2.25
United Eastern	4.37½
United Western	.04

BOSTON EXCH.*	Nov. 14
Adventure	4½
Ahmeek	116
Algomah	1⅛
Alloues	74½
Ariz. Com., ctfs.	17
Bonanza	.40
Butte-Ballakiava	2⅛
Calumet & Ariz.	89½
Calumet & Hecla	595
Centennial	22½
Copper Range	75⅛
Daly West	2½
East Butte	17½
Franklin	9½
Granby	99
Hancock	15½
Helvetia	.30
Indiana	3½
Island Cr'k, com.	62
Island Cr'k, pfd.	92½
Isle Royale	36
Keweenaw	5½
Lake	14⅛
La Salle	5½
Mason Valley	6½
Mass	17
Mayflower	3½
Michigan	4
Mohawk	99½
New Arcadian	6½
New Idria	15
North Butte	23½
North Lake	2½
Ojibway	2
Old Colony	3
Old Dominion	76½
Osceola	96
Quincy	97½
St. Mary's M. L.	91½
Santa Fe	2⅛
Shannon	9½
Shattuck-Ariz.	32½
So. Lake	6
So. Utah	.25
Superior	16
Superior & Bost.	7⅛
Tamarack	44½
Trinity	7⅛
Tuolumne	.60
U. S. Smelting	75½
U. S. Smelt'g, pf.	51
Utah Apex	3⅛
Utah Con.	21⅛
Utah Metal	7½
Victoria	7⅛
Winona	5⅛
Wolverine	50
Wyandot	1½

BOSTON CURB*	Nov. 14
Alaska Mines Corp.	.87
Bingham Mines	9½
Boston Ely	.70
Boston & Mont.	.78
Butte & Lon'n Dev.	.57
Calaveras	5⅛
Calumet-Corbin	.02
Chief Con.	2⅛
Cortez	.20
Crown Reserve	.43
Davis-Daly	5⅛
Eagle & Blue Bell	1½
Houghton Copper	1⅛
Iron Cap Cop., pf.	7
Mexican Metals	.45
Mines of America	1½
Mojave Tungsten	3⅛
Nat. Zinc & Lead	.60
Nevada-Douglas	1½
New Baltic	2⅛
New Cornelia	18
Ohio Copper	.24
Oneco	.75
Rex Cons.	.61
Rilla	.09
United Verde Ext.	39

SALT LAKE*	Nov. 14
Big Four	1.15
Black Jack	.06
Cardiff	7.25
Colorado Mining	.22
Crown Point	.05½
Daly-Judge	8.00
Emma Cop.	2.50
Empire Copper	1.15
Gold Chain	.17
Grand Central	.60
Iron Blossom	1.65
Lower Mammoth	.03½
May Day	.11
Opohongo	.01
Prince Con.	1.35
Seven Troughs	.04
Silver-King Coal'n.	3.05
Silver King Con.	4.15
Sioux Con.	.15
So. Hecla	1.70
Uncle Sam	.06
Wilbert	.08
Yankee	.20

TORONTO*	Nov. 14
Bailey	.07½
Beaver Con.	.41
Chambers Ferland	.17
Coniagas	4.75
La Rose	.53
Peterson Lake	.18
Right of Way	.05
Seneca Superior	‡.09
T. & Hudson Bay	73.00
Temiskaming	.62
Wettlaufer-Lor.	.09
Dome Exten.	.29
Dome Lake	.59
Foley O'Brien	.70
Hollinger	6.90
Jupiter	.27
McIntyre	1.88
Newray	1.04
Porcu. Crown	.70
Vipond	.38
West Dome	.34

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Nov. 14
Doctor Jack Pot.	.08½
Elkton Con.	.10
El Paso	.40
Findlay	.03
Gold Sovereign	.04
Golden Cycle	2.41
Granite	.60
Isabella	.22
Jack Pot	.04
Mary McKinney	.25
Portland	1.90
Vindicator	1.50

LONDON	Oct. 31
Alaska Mexican	£0 15s0d
Alaska Tre'dwell	2 15 0
Burma Corp.	4 0 0
Cam & Motor	0 12 0
Camp Bird	0 7 3
El Oro	0 9 3
Esperanza	0 10 9
Mexico Mines	3 17 6
Nechi, pfd.	0 13 6
Oroville	0 16 6
Santa Gert'dis	0 10 9
Tomboy	1 1 3

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	64.415	26.958	23.709	30.662
May	58.175	49.915	74.269	26.704	23.570	35.477
June	56.471	49.034	65.024	25.948	23.267	31.060
July	54.678	47.519	62.940	25.219	22.597	30.000
August	54.344	47.163	66.083	25.979	22.780	31.498
September	53.290	48.680	68.515	24.260	23.591	32.584
October	50.654	49.385	67.855	23.199	23.925	32.361
November	49.082	51.714	.....	22.703	25.094	.....
Dec.	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.684	.....	25.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April	16.811	27.895	75.096	124.319	*	137.389
May	18.506	28.625	77.600	135.457	*	152.522
June	19.477	26.601	82.574	112.432	95.333	137.455
July	18.796	23.865	76.011	95.119	91.409	125.500
Aug.	16.941	26.120	68.673	110.283	82.333	126.304
Sept.	17.502	26.855	68.915	113.905	85.250	134.071
Oct.	17.686	27.193	72.601	122.750	88.000	142.523
Nov.	18.627	.....	77.744	.....	93.273	.....
Dec.	20.133	.....	80.773	.....	100.430	.....
Year	17.275	.....	72.532	.....	.....	.....

Tin	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	51.230	166.225	199.736
May	38.790	49.125	162.675	196.511
June	40.288	42.231	167.636	179.466
July	37.423	38.510	167.080	168.357
August	34.389	38.565	151.440	169.870
September	33.125	38.830	152.625	171.345
October	33.080	41.241	151.554	179.307
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.590	.....	163.960	.....

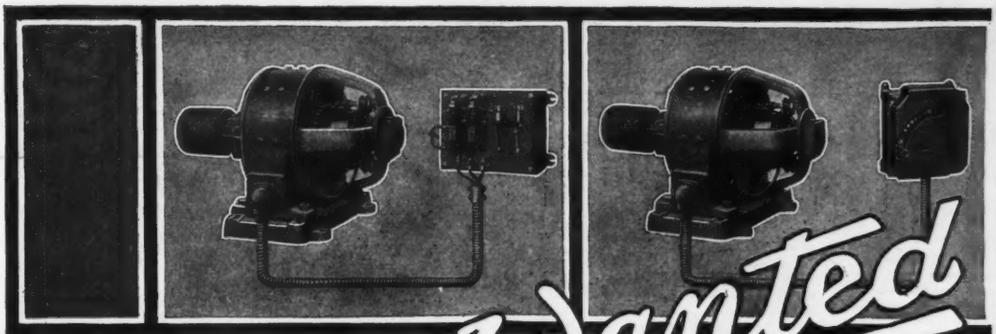
Lead	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221	7.630	4.142	7.655	21.094	34.368
May	4.274	7.463	4.182	7.332	20.347	32.967
June	5.932	6.936	5.836	6.749	25.170	31.011
July	5.659	6.352	5.531	6.185	24.611	28.137
August	4.656	6.244	4.520	6.088	21.946	29.734
September	4.610	6.810	4.490	6.699	23.151	30.786
October	4.600	7.000	4.499	6.898	23.994	30.716
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.673	.....	4.567	.....	22.917	.....

Spelter	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012	16.695	9.837	16.525	49.888	99.056
May	14.781	14.276	14.610	14.106	68.100	94.217
June	21.208	11.752	21.038	11.582	100.614	68.591
July	19.026	8.925	18.856	8.755	97.250	50.750
Aug.	12.781	8.730	12.611	8.560	67.786	51.587
Sept.	13.440	8.990	13.270	8.820	67.841	52.095
Oct.	12.800	9.829	12.596	9.659	66.536	54.159
Nov.	15.962	.....	15.792	.....	88.409	.....
Dec.	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	21.65	13.45	18.95	13.95	19.45
May	14.61	21.78	13.60	19.11	13.83	19.58
June	14.70	21.95	13.67	18.95	13.77	19.34
July	14.94	21.95	13.91	18.95	13.68	19.20
August	16.01	21.95	15.31	18.95	14.75	19.25
September	16.86	22.88	15.95	19.58	15.70	19.53
October	16.95	24.61	15.96	21.26	15.80	21.51
November	17.57	.....	16.47	.....	17.20	.....
December	19.97	.....	18.44	.....	18.95	.....
Year	$15.82	.....	$14.76	.....	$14.95	.....

‡ As reported by W. P. Snyder & Co.



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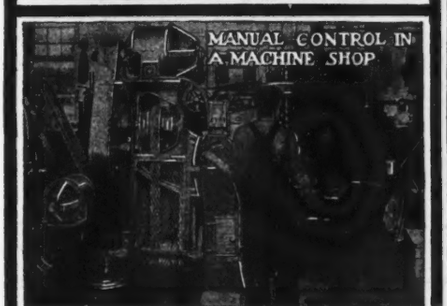

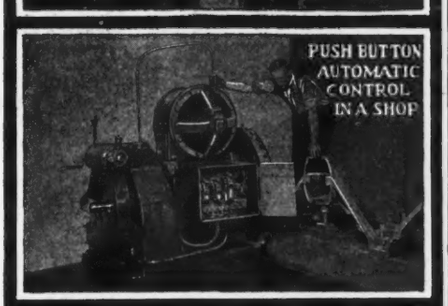

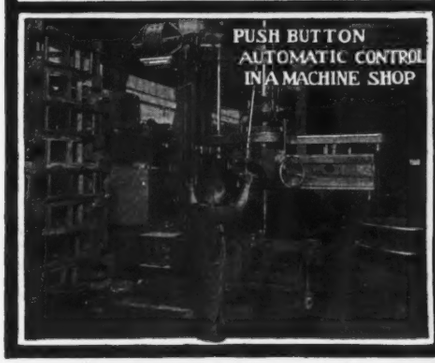

This trade-mark the guarantee of excellence on Goods Electrical

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Spokane, Wash.
Springfield, Mass.
Syracuse, N. Y.
Toledo, Ohio
Washington, D. C.
Youngstown, Ohio

For Michigan business refer to General Electric Company of Michigan, Detroit, Mich.

For Texas, Oklahoma and Arizona business refer to Southwest General Electric Company (formerly Hobson Electric Co.), Dallas, El Paso, Houston and Oklahoma City.

For Canadian business refer to Canadian General Electric Company, Ltd., Toronto, Ont.

General Foreign Sales Offices, Schenectady, N. Y.; 30 Church St., New York City; 83 Cannon St., London, E. C., England.

General Electric Company

General Office: Schenectady, N. Y.

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SPECIAL OPPORTUNITIES SECTION

Miscellaneous

ANSWERS addressed to us at 10th Ave. and 36th St., New York, or 1144 Monadnock Block, Chicago, will be forwarded without charge (excepting circulars or similar literature).

IMPORTANT: Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents — send copies. Advertisers' names will not be furnished under any circumstances. Copy received until 10 a.m. Monday for following Saturday's issue.

Positions Open

ENGINEER with actual mining experience wanted for India; position requires some knowledge of hydraulic mining; salary $250 per month; three years' contract; first-class passage to and from India. P442—Eng. & Min. Journal.

A MAN acquainted with copper converter wanted, construction and operation. Location in the middle west district. State age, experience, training and salary desired. P451—Eng. & Min. Journal, Chicago.

ASSAYER wanted immediately; college graduate; experienced in assaying low-grade gold ores with great accuracy; must have good record in this line and first-class recommendations; single man preferred; state age. Address A. A. Hassan, Riggs Building, Washington, D. C.

AN EXPERIENCED, UP-TO-DATE COAL-MINING ENGINEER wanted to open up and manage soft-coal mines in Spitzbergen, preferably a Scandinavian capable of handling Norwegian laborers. Employment beginning January. Address F. Hiorth, Josefinegade 13, Christiania, Norway.

WELL-KNOWN COLORADO MINE requires experienced flotation operator, competent to supervise tests and locate troubles. Salary $150; bonus if successful. State experience and qualifications; and give references. P458—Eng. & Min. Journal, Chicago.

EXPERIENCED MAN wanted, for running lead-bearing materials. State references, experience and salary expected. P456—Eng. & Ming. Journal, Chicago.

DRAFTSMAN wanted for work in New York City on design of metallurgical plant; capable men needed. Address Room 3262, 120 Broadway, N. Y. C.

ANALYTICAL CHEMIST wanted for lead smelter in middle west. Give full particulars, including salary desired. P453—Eng. & Min. Journal, Chicago.

Employment Agencies

The Agencies advertising here agree to refund any registration fee on demand any time within the first six months when no position is secured.

POSITIONS NEGOTIATED; mine, mill, smelter superintendents, operators, assayers, surveyors, master mechanics, electricians; all parts of world; established 13 years. If available engagement or needing men, write Business Men's Clearing House, Denver, Colo.

RATES—UNDISPLAYED

"Positions Wanted," 3 cents a word, minimum charge 50 cents an insertion, payable in advance.

"Positions Open" and all other undisplayed Want and For Sale advertisements, 5 cents a word, minimum charge $1 an insertion.

(When replies are to be received in our care, allow four words for the box address.)

DISPLAYED

1 inch one time—$2.50. Rates for larger spaces and longer terms furnished on request. Advertisements for bids (Proposals) $2.40 an inch.

NO REGISTRATION FEE is charged our clients; so are under no obligation to place unqualified men. Registrations accepted from desirable applicants only; so offer mining companies carefully selected men whose records warrant our recommendation. When requiring capable men of any kind write Mines Technical Agency, 1004 Washington Building, Los Angeles.

CORRESPONDENT

THE UNDERSIGNED plans and conducts correspondence for positions in technical, manufacturing and professional lines for $2,500 to $15,000 men exclusively. Complete privacy assured. No commission charged—only service fee and postage. Send name and address only, in confidence, for prefatory details. R. W. Bixby (established 1910), W1 Niagara Square, Buffalo, N. Y.

Positions Wanted

EXPERIENCED ZINC METALLURGIST seeks position with zinc smelting concern. PW436—Eng. & Min. Journal.

MINING ENGINEER, Columbia graduate, with six years of engineering and practical experience, seeks position; speaks Spanish. PW457—Eng. & Min. Journal.

SUPERINTENDENT—Smelter or electrolytic plant. Copper, lead, silver, bismuth and nickel experience covering sixteen years. Technical university graduate. Age thirty-six. PW448—Eng. & Min. Journal.

MINING ENGINEER and executive—Nine years' experience in development and examinations; at present and for past four years manager of well known and highly successful mining company; desires similar position or affiliation with a New York company whose business relates to mining. PW454—Eng. & Min. Journal.

METALLURGIST—Lead, silver and secondary metal blast and reverberatory furnace experience, as well as research and design work on both dry and wet processes. College trained. Age thirty-one. PW449—Eng. & Min. Journal.

COPPER SMELTERMAN, superintendent or foreman, 14 years' practical experience copper smelting with blast and reverberatory furnaces and converters in the United States and Mexico. Will furnish references, and go abroad. PW447—Eng. & Min. Journal, Chicago.

SUPERINTENDENT OR EXAMINING ENGINEER, 12 years' experience, American and foreign, in operation and examination; familiar with various systems of mining, capable of getting low costs and of appraising the possibilitfes of mining property; technical graduate; speaks Spanish. PW440—Eng. & Min. Journal.

NEW YORK CONNECTION with mining or brokerage concern or position as New York representative of outside company wanted by executive mining engineer with broad experience in examination and operation of mining properties; just completing successful term as resident manager of prosperous mining and reduction works. PW455—Eng. & Min. Journal.

Wanted

WANTED—Second-hand circular water-jacketed copper matting blast furnace; state particulars. W445—Eng. & Min. Journal, Chicago.

WANTED—To acquire mine of low-grade sulphide ore capable of producing 100 tons per day. Give location of property, terms considered, value and nature of mineral and kind of gangue. W450—Eng. & Min. Journal, Chicago.

FIFTY TO 75 TONS OF ANTIMONY ORE wanted, not less than 50% metallic antimony, low in copper, arsenic and lead; immediate delivery required; state full analysis and price f.o.b. New York W459—Eng. & Min. Journal.

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W 422—Engineering and Mining Journal.

WANTED

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Electric Mine Hoists

70 Hp. direct-current motors.
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4—General Electric Storage Battery Locomotives, 7 Hp., 30-in. gage.
2—Five-ton Garford Auto Trucks.
10—30-in. Gage Track Switches, 30-lb. rail.
11—30-in. Gage Track Crossovers, 30-lb. rail.
5—30-in. Gage Track Frogs, 30-lb. rail.
15—UF-2 Sullivan Rock Drills.
15—F-24 Ingersoll Rock Drills.
6—F-24 Ingersoll Tripods.
6—E-24 Ingersoll Tripods.
2—Superior Rock Drill Sharpeners.
2—8x6x12-in. Blake-Knowles Piston Pumps.
3—6½x4½x8-in. Blake-Knowles Piston Pumps.
3—Cameron No. 6-A Piston Pumps, 8x4x12 in.—100 gallons per minute, 4-in. suction, 3-in. discharge.
1—No. 5 Cameron Piston Pump, 7x3½x12 in.—50 gallons per minute, 2½ in. suction, 2-in. discharge.
1—Worthington Piston Pump—4½x2½x4 in.
1—Worthington Piston Pump—6x4x6 in.
4—No. 2 Roots Blowers without motors.
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Smith, Hauser, Locher & Co., 18 East 41st St., N. Y. City

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Answers to advertisements on the Want pages should always be addressed to the box number given in the advertisement, like this:

P1001
c/o Engineering & Mining Journal
10th Ave. at 36th St.,
N. Y. City

or

P1001
c/o Engineering & Mining Journal
1144 Monadnock Blk.,
Chicago, Ill.

Letters that do not give the advertisers' box number are subject to delay in forwarding.